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14. ABSTRACT
This final report details the IMMERSE effort under the SSIM program. SSIM is designed to address the challenge of training our warfighters to successfully engage with Others (people who are culturally different from oneself) to accomplish a diverse set of military missions. The SSIM IMMERSE effort involves demonstrating the possibility of conducting that training using an immersive, computer-based training system that embodies a mentored practice environment. As part of this effort, we are addressing key technical challenges including, developing interactive, immersive social situations populated by robust social agents, illustrating the keen eye and subtle guidance

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Report Title

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This final report details the IMMERSE effort under the SSIM program. SSIM is designed to address the challenge of training our warfighters to successfully engage with Others (people who are culturally different from oneself) to accomplish a diverse set of military missions. The SSIM IMMERSE effort involves demonstrating the possibility of conducting that training using an immersive, computer-based training system that embodies a mentored practice environment. As part of this effort, we are addressing key technical challenges including, developing interactive, immersive social situations populated by robust social agents, illustrating the keen eye and subtle guidance provided by a human mentor for social competence through intelligent tutoring, and enabling people to interact with simulated characters the way they interact with each other, through speech, gesture, comportment, etc.

Enter List of papers submitted or published that acknowledge ARO support from the start of the project to the date of this printing. List the papers, including journal references, in the following categories:

(a) Papers published in peer-reviewed journals (N/A for none)

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TOTAL:

Number of Papers published in peer-reviewed journals:

(b) Papers published in non-peer-reviewed journals (N/A for none)

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TOTAL:

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Number of Presentations: 0.00

Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

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TOTAL:

Number of Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

Peer-Reviewed Conference Proceeding publications (other than abstracts):

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08/31/2015	6.00	Daniel Shapiro, Larry LeBron, Andrew Stern, Michael Mateas. Aesthetic Interleaving of Character Performance Requests, 8th Workshop on Intelligent Narrative Technologies. 14-NOV-15, . : ,
11/12/2014	3.00	Michael Mateas, Josh McCoy, Daniel Shapiro, April Grow, Ben Samuel, Andrew Stern, Reid Swanson, Mike Treanor. Creating Playable Social Experiences through Whole-body Interaction with Virtual Characters, Ninth AAAI Conference on Artificial Intelligence and Interactive Digital Entertainment. 14-OCT-13, . : ,
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Received Book Chapter

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Graduate Students

NAME	PERCENT_SUPPORTED

FTE Equivalent:
Total Number:

Names of Post Doctorates

NAME	PERCENT_SUPPORTED

FTE Equivalent:
Total Number:

Names of Faculty Supported

NAME	PERCENT_SUPPORTED

FTE Equivalent:
Total Number:

Names of Under Graduate students supported

NAME	PERCENT_SUPPORTED

FTE Equivalent:
Total Number:

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This section only applies to graduating undergraduates supported by this agreement in this reporting period

The number of undergraduates funded by this agreement who graduated during this period: .....

The number of undergraduates funded by this agreement who graduated during this period with a degree in science, mathematics, engineering, or technology fields:.....

The number of undergraduates funded by your agreement who graduated during this period and will continue to pursue a graduate or Ph.D. degree in science, mathematics, engineering, or technology fields:.....

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NAME

Total Number:

Names of personnel receiving PHDs

NAME

Total Number:

Names of other research staff

NAME	PERCENT_SUPPORTED

FTE Equivalent:
Total Number:

Sub Contractors (DD882)

1 a. Smart Information Flow Technologies (SIFT)

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Sub Contractor Numbers (c):
Patent Clause Number (d-1):
Patent Date (d-2):
Work Description (e):
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Sub Contract Est Completion Date(f-2):

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Yellow Springs OH 45387

Sub Contractor Numbers (c):
Patent Clause Number (d-1):
Patent Date (d-2):
Work Description (e):
Sub Contract Award Date (f-1):
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Sub Contractor Numbers (c):
Patent Clause Number (d-1):
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1156 High Street
Santa Cruz CA 950641077

Sub Contractor Numbers (c):

Patent Clause Number (d-1):

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Scientific Progress

Table of Contents

Technology Transfer

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Program:	Strategic Social Interaction Modules (SSIM)
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Table of Contents

Document History

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1.0	August 28, 2015	Updated conclusion and acknowledgements and copy edits.

1. Document Overview

This Final Report describes BBN's IMMERSE project, funded as part of the Defense Advanced Research Projects Agency (DARPA) Strategic Social Interaction Modules (SSIM) program.

Section 1 Document Overview provides an overview of the document.

Section 2 Project Overview provides an overview of the IMMERSE project, its purpose, the concept of operations for the resulting capability, and a description of the team.

Section 3 Accomplishments & Major Milestones describes the major demonstrations, system deployments, and publications and presentations made as part of the IMMERSE effort.

Section 4 Simulator System Description describes the functional details of the IMMERSE Social Simulator, including the system architecture and major functional components.

Section 5 Expressive Artificial Intelligence for Social Immersion describes the technologies developed for supporting the IMMERSE Social Simulator with its unscripted social interaction with virtual characters.

Section 6 Social Pedagogy describes how pedagogy is manifest within the IMMERSE Social Simulator, including the design of social encounters, social simulation as a training vehicle, the social coach, the role of the pedagogic director, and after action review.

Section 7 Additional Knowledge Products briefly describes two additional knowledge products developed under the IMMERSE project: a Gap Analysis Study by MacroCognition, seeking to identify the gaps between the Good Stranger (GS) skills needed and those possessed by the military personnel, and research by SIFT to determine how to best represent "body behaviors" within the framework of the Etiquette Engine, previously developed as an adjunct to DARPA's DARWARS projects.

Section 8 Lessons Learned details a series of lessons learned in developing the IMMERSE Social Simulator.

Section 9 Unanswered Questions about Social Interaction with Virtual Characters highlights a number of outstanding issues involving a player interacting with virtual characters.

Section 10 Recommendations on the Way Ahead discusses areas for further research in order to expand the state-of-the-art in social simulation.

Section 11 Conclusion looks ahead to the Army's "Seventh Warfighting Requirement".

Section 12 Acknowledgements recognizes the many contributors that have added to the success of the IMMERSE project.

Section 13 Appendices contains a list of symbols, abbreviations, and acronyms, document references, a subsection on system development history, a subsection on the software developed to facilitate visualization of the virtual social experience, and reports from SIFT and MacroCognition.

2. Project Overview

2.1 Purpose

The DARPA SSIM program was designed to address the challenge of training our warfighters to successfully engage with people from other cultures in order to accomplish missions where success hinges on social competence. As part of this program, BBN's IMMERSE effort aimed to demonstrate the possibility of conducting training using an immersive, simulation-based training system, called the Social Simulator, to create a mentored, social-interaction practice environment. Technical challenges included developing interactive synthetic social situations populated by robust, believable agents and providing a synthetic coach to deliver feedback and guidance. In the Social Simulator, trainees can expect to interact with simulated characters the same way they interact with other people, through speech, gesture, comportment, and other forms of nonverbal communication.

The original vision for DARPA's SSIM program was to understand, measure and teach the ability to be a "good stranger" – to interact effectively with people from other cultures without trying to be accepted as a member of that culture. Because the expected SSIM learners were to come from the military and law enforcement, SSIM focused on interactions with the potential for kinetic escalation (violence breaking out) and where the learner was often trying to "gain compliance" — get members of another culture to do something or provide information. In keeping with the good stranger vision, the Social Simulator does not teach culture-specific skills, knowledge and behavior; rather, it aims to sensitize the learner to anticipate and perceive culture-specific behavior and adapt to it in the field. The Social Simulator is composed of two elements: MiBA and IMMERSE. MiBA senses and recognizes learner actions and passes them to IMMERSE, which interprets the actions in a simulated social environment.

Conceptually, the design for the Social Simulator began with the following notion: if social competence is a skill, then it can be trained through relevant practice with feedback. Practice of real-time, embodied, cognitively rich skills is made more comprehensive by embodied interaction, real-time dynamism and socio-cognitive richness. Thus the virtual characters (VCs) that inhabit IMMERSE must be able to detect, interpret and react to the full body behaviors of the learner in real time. They must then behave as if they are part of the many overlapping social interactions that make up multi-person, social settings.

Besides this basic assumption, the design was guided by two secondary principles:

1. Performance Hypothesis: High fidelity simulation is not enough. The simulated characters must *perform* social actions (as in the kind of thing actors and actresses do to make their behavior meaningful to an audience) in order to enable pedagogically effective social interaction.
2. Social Coaching Hypothesis: Coaching social competence is especially sensitive to the social competence of the coach.

The IMMERSE portion of the SSIM effort is an engineering effort aimed at building a prototype rather than a validation-oriented experimental effort. It has attempted to demonstrate that a system can be designed and built to effectively exploit these hypotheses and to enable experiments to test them. That said, there is real benefit to be gained if systems based on these conjectures and the Social Simulator prototype can be built and fielded – the simplest being the existence of a scalable technology for delivering social training, given that the current best

practice—human role-play based training—is expensive, logistically cumbersome, and prone to systematic weaknesses such as role player fatigue.

2.2 Concept of Operations

Interacting with the Social Simulator is meant to be a natural experience for the learner. The learner stands in front of a large display, such as a 70" screen, equipped with a microphone and a Kinect 2 sensor. Figure 1 illustrates the physical layout of the environment. The learner is free to move around in front of the display within an 11.5 ft. deep by 11.5 ft. wide region, as constrained by Kinect 2 sensor. We utilize a noise cancelling, wireless microphone to overcome background noise, but the Kinect 2 sensor also offers a built-in microphone array, which can be utilized to reduce hardware requirements. Depending on the scenario, the learner may employ a simulated weapon that contains an embedded game controller. Figure 2 illustrates a user interacting with the system.

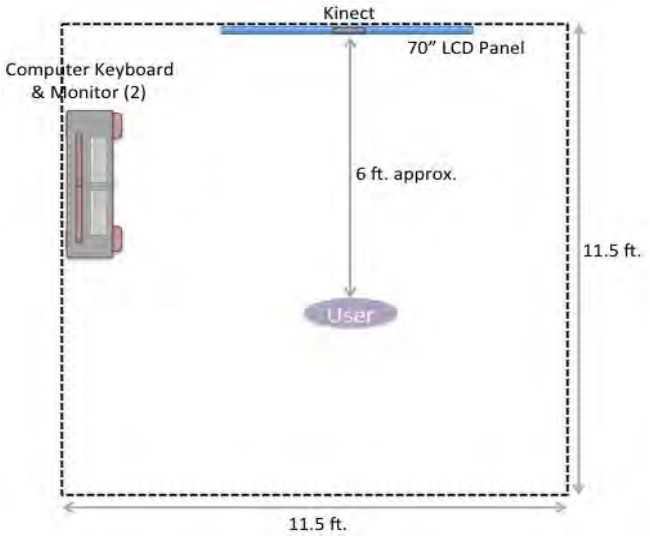

Figure 1: Top-down view of Social Simulator physical layout.

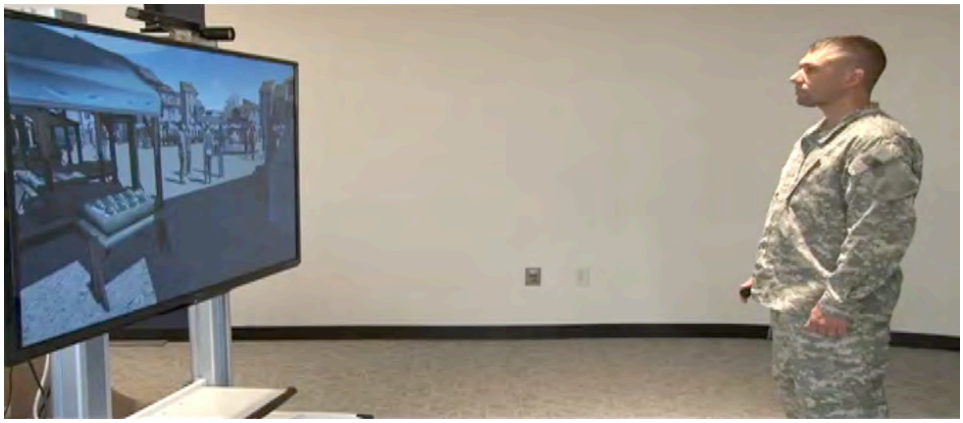

Figure 2: Trainee interacting with the Social Simulator.

A typical session with a learner involves short system configuration phase and a short mission briefing, after which the learner moves into the scenario, which lasts on the order of two to ten minutes. During the scenario, the learner interacts with social virtual characters, including a

virtual coach, which provides guidance and feedback as appropriate. After the scenario, the system provides an after action review (AAR) describing effective and ineffective learner behaviors and suggesting what the learner might do to perform better in the scenario.

2.3 Team

The IMMERSE project team (See Figure 3) included Raytheon BBN Technologies, whose responsibilities include integration, the virtual environment, and coaching; the Center for Games and Playable Media at the University of California, Santa Cruz, who focused on social simulation, behavior modeling, and performance; Fire Hose Games, who developed the art and non-dialog audio assets necessary for the virtual environment; MacroCognition LLC who assisted in the design of social interaction skills training, and acted as a liaison with the social scientists on co-contractor teams; Smart Information Flow Technologies (SIFT), who designed capabilities for assessing etiquette perceptions and misperceptions among culturally diverse participants; and Dr. Alan Collins, who served as a senior advisor on cognitive apprenticeship, situated cognition, and tutoring.

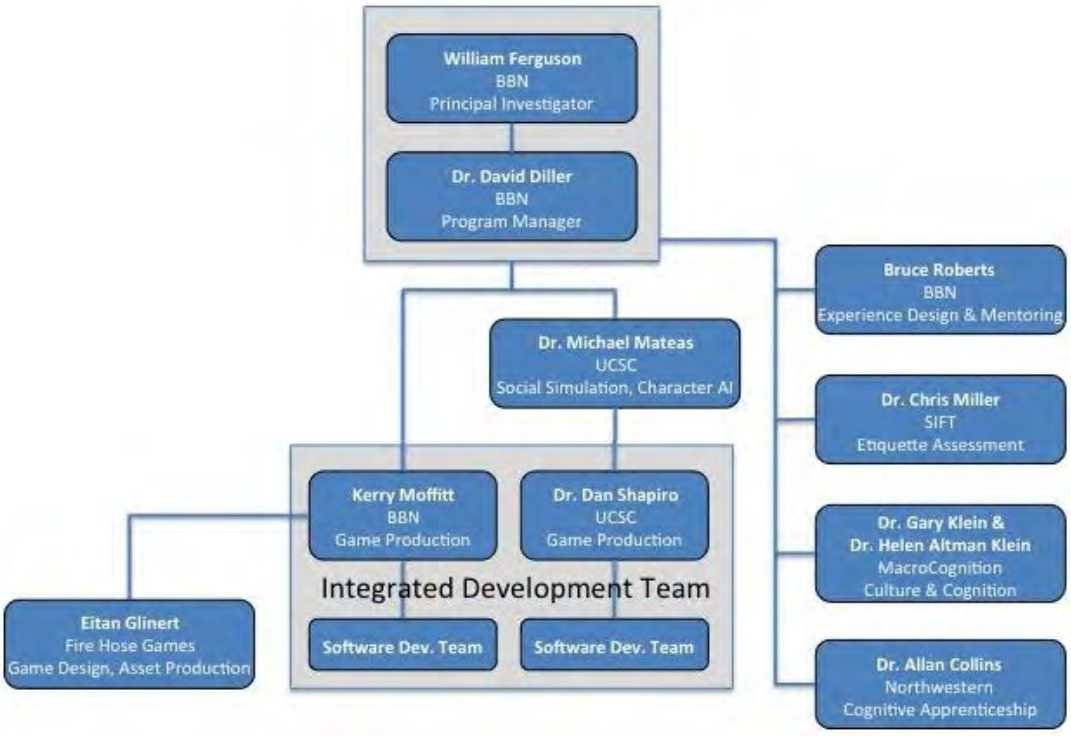

Figure 3: IMMERSE Project Team

3. Accomplishments and Major Milestones

Figure 4 depicts the major milestones and events that defined the IMMERSE project. Semi-annual PI meetings provided the most obvious yardstick for measuring progress. With the exception of the kickoff meeting in October 2011, each PI meeting became an occasion for demonstrating progress by showcasing a new interactive scenario – highlighting different types of social encounters – or technology. Section 3.1 describes the experiences offered by each of the five demonstation scenarios. In the final year of the project, working systems were deployed to three sites, as described below in Section 3.2. Section 3.3 lists publications, presentations and panel participation.

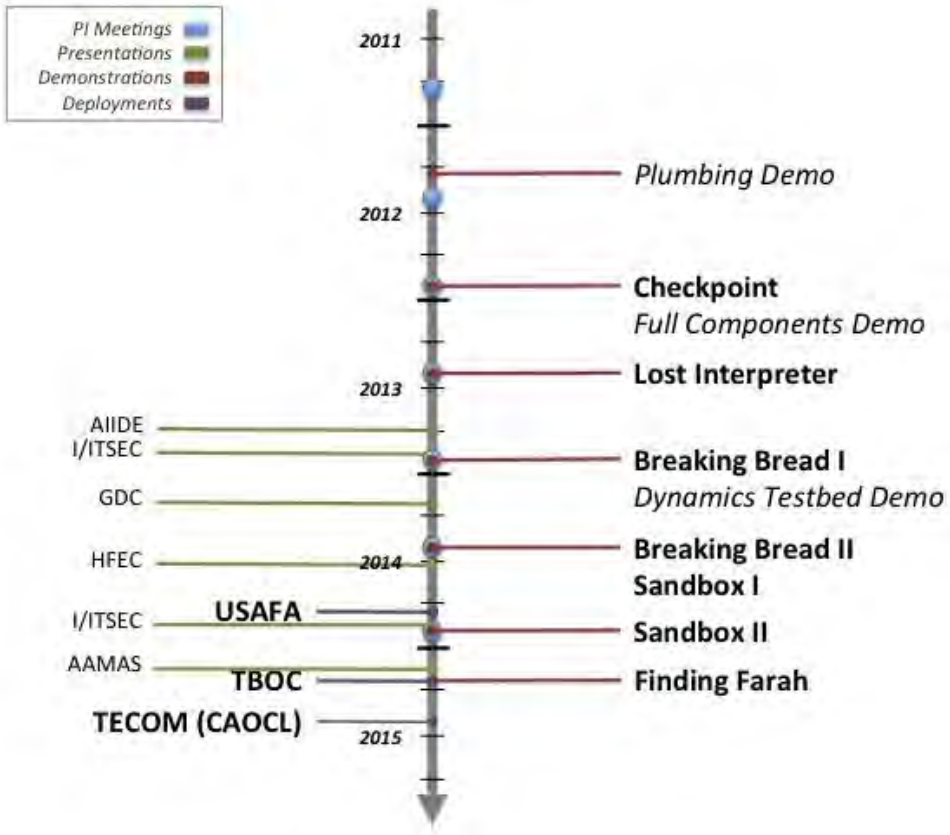

Figure 4: IMMERSE Timeline

3.1 Demonstrations

3.1.1 Checkpoint Demonstration

Figure 5: Screenshot from the Checkpoint Scenario

Phase 1 of the IMMERSE effort was largely about assembling existing components and creating something new with the composition: a functioning Social Simulation Architecture. In the first year, we bootstrapped the process by developing a scenario focused on a type of checkpoint commonly known as an entry control point, at a food distribution warehouse. This scenario was designed to illustrate that:

1. Trainees are immersed in an ongoing social milieu.
2. VCs interact socially with each other, and with the trainee.
3. The trainee is standing, unencumbered, and interacts with the VCs using normal gestures, poses, facial expressions, and speech (including paralinguistic features). Actions are interpreted based on the social context in which they occur and the understanding of individual VCs.
4. Social interactions are not scripted; they play out according to specific rules of social behavior applied to the evolving, shared social context and the particular individuals (VCs) involved in the exchange.
5. Against this realistic social backdrop, a simulated mentor shapes the learning experience and provides guidance and feedback to the trainee.
6. The training focuses on improving social skills, especially those of value in cross-cultural settings. These include *meta-cultural skills* like observation, imitation, experimentation, de-centering (seeing events through another's eyes); *self-monitoring skills* like self-awareness, emotional control and other forms of self-regulation; and *encounter management skills* like understanding the structure of encounters, recognizing and repairing communication failures, and techniques for escalation and de-escalation.

7. These skills need to be adapted and applied in a variety of environmental and social conditions; e.g., social setting, stress level, number of participants, time pressure, language ability, cultural background, etc.

In the Checkpoint scenario, the player is in charge of checking the identification of people who want to enter a Non-governmental organization (NGO) facility, located in the outskirts of a foreign village.

- At first a British soldier walks up, and hands the player an identification card. The player needs to hold the ID up to their face, and then hand it back to the soldier, who then thanks the player and walks past the player.
- A few local civilians are next in line, but the man at the front of the line does not approach. The player has to beckon for the man to approach, who gestures and speaks in their local language.
- The player may (repeatedly) gesture and speak to try to communicate that an ID is required. The man seems to not understand, and gets frustrated. He eventually turns to his friends behind him, who seem upset as well.
- The player can gesture for the man to step aside, and walk over to a different place to stand. The man reluctantly complies.

3.1.2 Lost Interpreter Demonstration

Figure 6: Screenshot from the Lost Interpreter Scenario

Considerably more ambitious than the Checkpoint scenario, Lost Interpreter focused on group dynamics, in particular the social conventions that determine how a small number of people in conversation recognize and accommodate to a new member joining the group. We also explored techniques for player locomotion within the scene, by introducing a small handheld controller,

and the intricacies of transferring objects – a photograph – between the real and virtual world. Finally, the scenario presented an explicit goal – find the interpreter – but allowed the player free reign for how to accomplish this.

The Player is in a foreign village marketplace, holding a photograph of an interpreter they have been told to meet. There are various groups of people standing throughout the marketplace. The player has free navigation, via a handheld wireless controller/joystick.

The following interactions are possible in Lost Interpreter:

- The player approaches the closest group, who smile and seem friendly, and open up their circle to include the player.
- The player can show and point at the photo. One VC will ask for it, and the player can hand it to them. They will pass the photo around, looking at it. One VC will point toward another group of three men nearby.
- The player can gesture for the photo back, and get it, and then walk over to the group of three men.
- These men look reticent when the player approaches. When asked about the photo, one seems to recognize it and looks anxious, but the senior man in the group mutters something that quiets the other two. Further asking about the photo seems to annoy the senior man.
- The player has to make a stronger emotional appeal gesture to the senior man, to get him to point toward the fountain in the center of the square, where the player can see the interpreter off in the distance.
- As the player moves toward the fountain, the interpreter gets lost in the crowd.

3.1.3 Breaking Bread Demonstration

Figure 7: Screenshot from the Breaking Bread Scenario

Breaking Bread was modeled after an actual event. It was designed to situate the Player in a familiar mission (knock and search) with a high probability of escalation in order to emphasize the ever-present concern for balancing tact and tactics in social situations. This scenario

introduced the notion of Social Games (see Section 5.1 below) as the mechanism for guiding VC-VC and VC-Player interactions, which allowed for greater emotional breadth in the VC behaviors. We also gave the player a weapon – a plastic AR-15 – to add additional affordances for the player to consider.

The Player is introduced to the scenario as follows:

- You are the leader of a US team that has just started working alongside and training a local national (LN) military unit. The primary US role in this region is wide area security. You deployed on short notice and arrived in the region with very little background knowledge of the culture or the language. But so far things are going well.
- You're currently on a patrol with the LN unit to sweep (knock and search) several houses in a village that are suspected hiding places for contraband – emergency medical supplies that did not arrive at their intended destination. People tend to keep weapons in their homes, but the environment is generally viewed as permissive.
- The LN team has the lead; you are here to observe, advise, and assist. This is only your second patrol with your local national counterpart, and the first time you have been in this village. You understand that the LN soldier (LNS) is from a neighboring village and he speaks almost no English. His name is Basuki.
- You enter the first house. The head of the household (HoH) invites you and your LNS into the kitchen. The rest of the team, including your interpreter, goes off with another household member to search the rest of the house. You (the Player) and the LNS follow the HoH into the kitchen. You suspect he might be an important person in the village.

Here are several possible outcomes for the encounter:

- In the kitchen of a home, the head of household (HoH) is an older civilian man, very wary of both the player and the LNS. The LNS is young and arrogant.
- After an initial greeting, the HoH offers the player fruit, in an act of goodwill. Meanwhile the LNS, is wandering around the kitchen, picking up objects without asking, which begins to anger the HoH. The player can gesture for the LNS to stop doing that and/or to come stand with the player, which builds rapport with the HoH.
- The LNS and/or the player can point to some cabinets, and ask the HoH to open them. Depending on the level of rapport, the HoH may initially balk. Eventually the HoH will reluctantly open a cabinet, showing it is empty.
- The player has the option of gesturing for the HoH to calm down, including putting a hand on the HoH's shoulder, in an attempt to pacify him.
- The LNS and/or the player can ask for a second cabinet to be opened, which reveals storage of illicit medicine.
- The LNS eventually picks up a piece of bread on the table, to eat it. This infuriates the HoH, who smashes a bowl of fruit in defiance.
- In response to that possible threat of violence, the LNS and/or the player may raise their rifles to a low-ready. This causes the HoH to become frightened and call for his son, who enters the room, scared and angry, yelling at the LNS and player to leave. The player can gesture for the LNS and player to leave the kitchen, to de-escalate the situation.
- Alternatively, if the player had prevented the LNS from eating bread, the HoH may be less upset. The son will eventually wander in, and the HoH will introduce him to the LNS and

player, at which point the player can gesture for LNS and player to leave calmly.

An alternative version of Breaking Bread was partially implemented in which the HoH is female and the LNS is submissive, indicating that you have found yourself in a matriarchal society.

3.1.4 Sandbox Demonstration

Figure 8: Screenshot from the Sandbox Scenario

The Sandbox is an outgrowth of the earlier dynamics testbed demonstration, and reflects the realization that, while scenario-based training is very important, it is not the only framework for delivering meaningful social experiences. The Sandbox situates the learner in a village square in an unfamiliar country. Two characters appear, one carrying a box of fruit. They do not speak English but are friendly, inquisitive, accommodating and inclusive; their objective is to interact with the learner and to draw the learner into the experience. For example, they may engage in the following behaviors:

- Mirror some learner behaviors: smiles, bows, waves and head nods.
- React to other learner behaviors in simple ways; e.g., look in the direction the learner points, approach when beckoned, or startle if the learner makes a loud vocalization.
- Engage in simple exchanges; e.g., at the learner's request pass objects to the learner and take them back. They can get into mild disputes with each other during these transactions.
- If the learner is idle, try to get the learner's attention.

The long-term goals for the Sandbox were three-fold: 1) to invite learners to interact with the system, 2) to familiarize learners with behaviors that the virtual characters can recognize and react to, and 3) to serve as a low-key practice environment for a variety of simple social interactions. It also rewards fundamental meta-cultural skills: observation, mimicry, engagement, and calmness in the face of trouble that inevitably arises in social interaction. The highly reactive and playful nature of the VC reactions, along with the easy pace of the experience – nothing happens if the learner takes a long time to do things except for attempts to introduce them to new

behavior – provides a very low engagement barrier as well as the gratification of nearly instant social feedback.

The following interactions are possible in the Sandbox:

Transactions
The box of fruit provides opportunities for offering and requesting, accepting and refusing. Many variations on this theme are possible:

- When the Player extends his right hand toward a VC holding some fruit, the VC will approach and offer it to the Player. In addition, the VC may spontaneously offer fruit to the Player, but not every time.
- The Player can take the offered fruit by extending his hand.
- The Player can eat the fruit by holding his hand to his mouth to mime eating. It is possible to eat the entire box of fruit, one at a time. When the box is empty, the VCs will bid farewell and leave.
- The Player can give the fruit back by extending his hand toward a VC who is not holding anything. The VC will approach and take the fruit. Offering fruit to a VC who is already holding fruit will spark a refusal.

VCs spontaneously engage in the giving, taking and eating fruit, and may encourage the Player to participate in this activity.

Compound Gestures
The Player can use compound gestures to direct the VCs.

When the Player points at a VC, then points to himself, this is interpreted as a request to approach.

Show Gratitude
The hand-to-heart gesture is interpreted as thank you, as is a bow or Namaste. The VC will mirror the gesture, and may introduce the hand-to-heart gesture when accepting fruit from the Player.

When the Player smiles, VCs will smile back.

Exchange of Names
When the Player looks at a VC, points at himself and speaks, the VC interprets this as an introduction and will introduce himself by name. VCs persist in referring to the Player as “Americano” however. In addition, VCs may spontaneously introduce themselves to the Player. The VC with the box of fruit is “Basuki”; the other VC is “Yunos”.

Direct Attention
In general, pointing directs the attention of the VCs. The Player can point at a VC, or off-screen – up, down, left or right.

When the Player says the name of a VC, the VC will respond. If the name is accompanied by a gesture – e.g., beckon – the named VC will respond.

Surprise
When the Player yells loudly or rushes the screen, the VCs act surprised.

Agreement
VCs mirror these behaviors:

- Head nod – VC nods head
- Head shake – VC shakes head

A Stop, Stop That or Request Step Back gesture will interrupt whatever the VCs are currently doing or to take a step back away from the Player.

Closing
When Player leaves the stage (backs away or steps sideways out of view), the VCs wave goodbye, turn, walk away, and go about their business in the square.

3.1.5 Finding Farah Demonstration

Figure 9: Screenshot from the Finding Farah Scenario

This scenario provides the Player with a more specific goal than just interacting with VCs in a village square. It incorporates the social interactions introduced in the Sandbox demonstration, but takes place in an urban setting and introduces a simple mission goal of trying to solicit help from a VC in locating a person, Farah. The instructional focus of this scenario is to recognize that time spent at the beginning of an encounter building rapport and gaining trust will pay dividends in accomplishing the mission.

The Player is said to be in an unfamiliar country on a humanitarian relief mission: to support the local authorities to contain an infectious disease outbreak. It is important to track down people who may have been infected without their knowledge so they can be treated before they infect others. In the Player's left hand is a picture of a woman named Farah, who needs to be found. She supposedly lives nearby.

One VC recognizes the person in the photo, but is reluctant to reveal this. He will show subtle signs of recognition, and some unease, but that's all. Repeated attempts by the Player, prior to establishing some kind of rapport, will produce reactions of increasing annoyance, leading to the VCs breaking off the encounter altogether.

Rapport building entails offering greetings, introducing oneself, taking and eating the fruit that is proffered by the VCs, asking for more fruit, or showing interest in the surroundings, and, above all, being patient.

A second VC is much more suspicious, and will actively discourage the other from helping in any way. The Learner may choose to assert himself in resolving or overriding this conflict between the VCs, which can lead to the knowledgeable VC grudgingly complying with the request to help find the person in the photo. A better outcome occurs when the Player invests effort initially in building rapport, and the VC willingly complies and offers to take the Learner to meet the person. A worse outcome occurs when the Players focuses exclusively on the question of identity, and the VCs become annoyed and leave without revealing any information.

The three possible results represent natural outcomes based on the learner's competence as a good stranger, they follow from the SSIM social science results and can serve as the context for pedagogical interactions between the system and the learner (coaching and AAR) that will help the learner succeed and understand the consequences of his or her actions. The experiences produced by the system constitute a kind of social puzzle that could be a natural part of intelligence gathering, disaster relief or other military missions.

The following interactions are possible in Finding Farah:

- On a quiet morning in a city square, the player encounters two strangers – two civilian men who are friends with each other: Basuki, who is carrying a box of fruit, and Yunos. They notice the player, approach and greet the player, and attempt to build rapport by using gestures, while speaking in their native tongue.
- Yunos, somewhat friendly, tends to try to get Basuki to offer the player some fruit; Basuki is wary and resists. Yunos may eventually take some fruit from Basuki and offer it to the player, who can take it and eat it, which builds rapport.
- If the player tries to show them and ask about the photo before building some rapport, they are hesitant, and Basuki commands Yunos not to answer. If the player badgers them about the photo, they will become annoyed and walk away.
- If the player asks about the photo after building rapport, they are more likely to answer, pointing off-screen to where Farah is, and inviting the player to follow them to her.
- If the player asserts authority by commanding the resistant Basuki to step back, Yunos may angrily give you information about Farah, regardless of rapport, and then leave without inviting the player to follow them.

3.2 Deployments

In order to illustrate the capabilities of the SSIM simulator and its potential for training, as well as to disseminate the lessons learned during the development of the SSIM simulator, the simulator prototype system has been deployed three times to DoD organizations, which can evaluate its potential and communicate that potential to a wider circle of DoD entities that would

benefit from training based on SSIM technology. BBN, working under the direction of DARPA, deployed prototypes at the following three organizations.

3.2.1 United States Air Force Academy

In November 2015 we deployed a version of the SSIM simulator to the Warfighter Effectiveness Research Center at U.S. Air Force Academy in Colorado Springs. They were eager to have their cadets evaluate the experiences produced by the system and to give feedback on its operation. BBN suggested that it might be appropriate to measure social engagement (as opposed to ordinary engagement with a software system) between the human learner and the virtual characters. Air Force Academy cadets designed and executed evaluation experiments as part of their capstone activities during the 2015 spring semester. They presented the results of their work to DARPA SSIM leadership on May 6th, 2015. Among other findings they reported that more than 60% of the test subjects felt that the initial prototype was useful; they wished it had a more defined mission and gave feedback (both capabilities have been addressed in the final prototype). The Air Force Academy intends to continue evaluating the final version of the SSIM prototype system, which they received in May of 2015.

3.2.2 US Army Training Brain Operations Center

In March 2015 we delivered a version of the SSIM simulator to the U.S. Army Training Brain Operations Center (TBOC) in Newport News VA. We trained TBOC personnel on the system's operation and purpose and also conducted detailed technical overviews of the system with TBOC's programming staff. They intended to show the system to various potential users (from DoD and the Intelligence Community) of the technology in the SSIM system.

3.2.3 US Marine Corps Center for Advanced Operational Culture and Learning

In May 2015 we delivered the final version of the prototype to the U.S. Marine Center for Advanced Operational Culture Learning (CAOCL) at TECOM in Quantico VA. CAOCL personnel were trained to operate the system. CAOCL intends to evaluate SSIM technology for its utility in Marine education and training. Their evaluation is to take place during the following year.

3.3 Publications and Presentations

The following publications and presentations were conducted by members of the IMMERSE team as part of the SSIM effort.

Ferguson, W., Roberts, B., Diller, D., Shapiro, D. and Mateas, M. Teaching Cross Cultural Social Competence in a Dynamic, Synthetic Environment. *Proceedings of the Interservice/Industry Training, Simulation, and Education Conference*, Paper No. 14289, Orlando, FL, 2014.

Gratch, J., Mateas, M., Ross, T., Johnson, W.L., Ferguson, W., & Butler, W. (2013). Artificial Intelligence for Social Interaction Simulation. *Special Panel Session of the Interservice/Industry Training, Simulation, and Education Conference*, Orlando, FL, 2013.

Klein, G., Klein, H. A., Lande, B., Borders, J., & Whitaker, J.C. (2014). The Good Stranger frame for police and military activities. *Proceedings of the Human Factors and Ergonomics Conference*, Sept 2014.

Klein, H. A. and Borders, J. (2015). *Good Stranger Diagnostic Tool: Measuring capacitates and limitations to inform training.* Accepted for presentation at the 12th International Naturalistic Decision Making Conference, McLean, VA.

Klein, G., Klein, H. A., Lande, B., Borders, J., Whitacre, J. C. (2015). Police and military as Good Strangers. *Journal of Occupational and Organizational Psychology – Special selection paper* (2015).

Mateas, M. and Ferguson, W. (2014). Social Legos: Toward Modular, Reusable Social Behavior. *Proceedings of the 2014 Game Developers Conference (GDC)*, San Francisco, CA.

Shapiro, D., McCoy, J., Grow, A., Samuel, B., Stern, A., Swanson, R., Treanor, M., and Mateas, M., Creating Playable Social Experiences through Whole-body Interaction with Virtual Characters (2013). *Proceedings of the Ninth AAAI Conference on Artificial Intelligence and Interactive Digital Entertainment (AIIDE13)*, Boston, MA.

Shapiro, D., Tanenbaum, K., McCoy, J., LeBron, L., Reynolds, C., Stern, A., Mateas, M., Ferguson, B., Diller, D., Moffitt, K., Coon, W., and Roberts, B., Composing Social Interactions via Social Games, I*nternational Conference on Autonomous Agents and MultiAgent Systems (AAMAS)* 2015, Istanbul, Turkey.

4. Simulator System Description

The following section describes the Social Simulator System's primary components and the architecture used to integrate these components.

4.1 System Architecture

Figure 10 shows the top-level system architecture. The learner, shown at the far left in Figure 10, interacts with the system in the same way the learner would interact with real people: through speech, gestures, comportment, and other forms of nonverbal communication. Learner input into the system is handled by the learner-sensing system, MiBA (Multimodal Integrated Behavior Analysis), which takes body and voice input from a Kinect 2 sensor and microphone; analyzes the learner's gaze, facial expressions, body pose, gestures, speech, speech vocalics, and multimodal affect; and outputs this analysis as a rich physical description of learner behavior. These signals are passed along to the Social Pragmatics (SP) module, which performs the last stage of input interpretation in order to provide data in a form comprehensible to the Social Simulation Engine and Performance AI components. The Social Simulation Engine creates a rich social environment for learning and models the high and intermediate level activities of the learner and the VCs, while its tightly integrated companion the Performance AI module determines the moment-by-moment behaviors of the VCs and the coach. Performance AI drives all of the system output seen and heard by the learner, which is ultimately presented by the Virtual World Simulator: the game engine rendering the VCs and the simulated environment. The Pedagogical Director (PD) is responsible for assessing the learner and influencing the learner's experience to provide an effective, individualized and varied training experience. Coaching, which is very much a social interaction itself, is implemented using the mechanisms of the Social Simulation Engine and the Performance AI. Each of these components is described in more detail in the sections below.

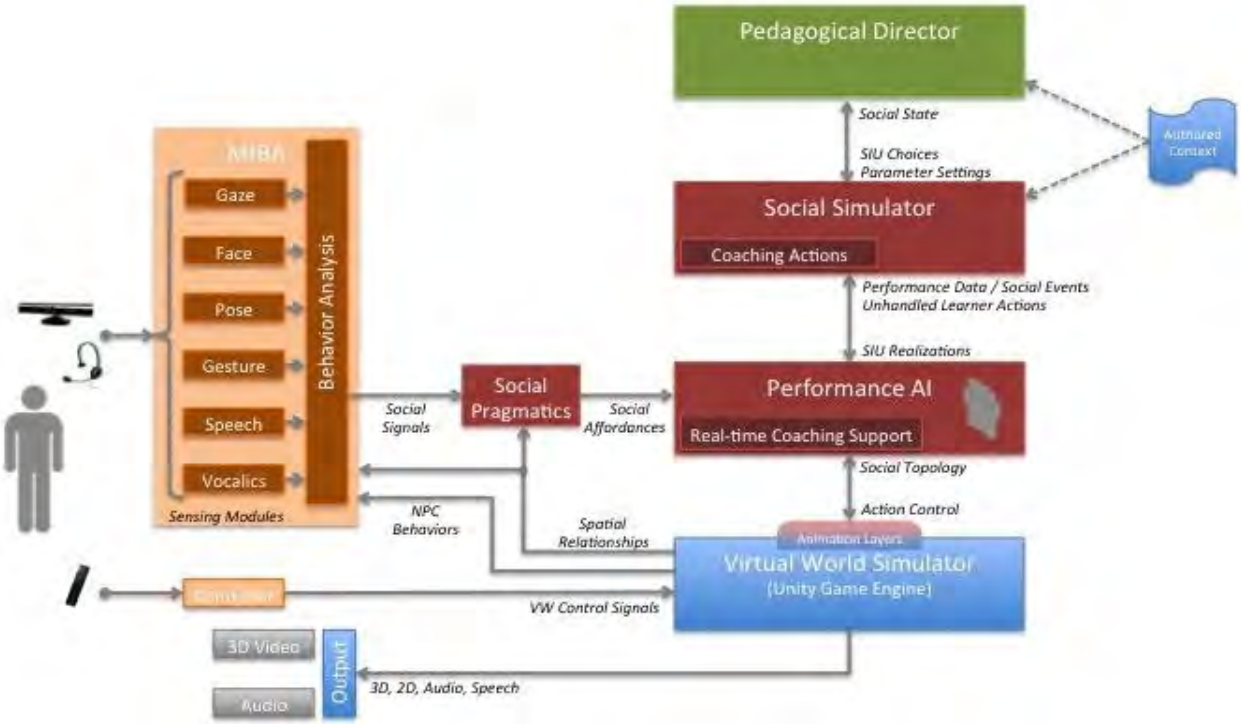

Figure 10: System Architecture

4.2 System Components

4.2.1 MiBA

The Multimodal Integrated Behavior Analysis (MiBA) sensing application was developed by SRI International's Princeton research laboratory, and serves as the eyes and ears for the Social Simulator. It runs on a separate computer and takes input from a Kinect 2 sensor and separate microphone and analyses the learner's gaze, facial expressions, body pose, gestures, speech, speech vocalics, and multimodal affect and converts this input into a rich set of possible social interpretations. These signals are passed along to the Social Pragmatics component, which performs the last stage of input interpretation.

4.2.2 Social Pragmatics

The Social Pragmatics component serves dual, complementary roles as a translator, reading the streams of raw data that MiBA provides and distilling them into events that the Social Simulation Engine can understand; and as a careful filter, implementing pragmatic, empirically-designed rules that govern exactly which MiBA signals (at what strength and for what duration, with or without other signals) should generate events for the Social Simulation (See Section 4.2.3).

In a sense, Social Pragmatics acts as a kind of bridge to a utopian world: if some perfect MiBA existed, that behaved exactly as we might hope (an impossibly tall order given the messy nature of the world it's sensing and the constraints imposed by the hardware on which it relies) there would be no role for Social Pragmatics; MiBA would simply connect directly to the Social Simulation and issue events without mediation. One can see this play out in the co-evolution of MiBA and Social Pragmatics over time: as MiBA improved over the course of the project and its output became more consistent and reliable, the complexity and role of Social Pragmatics diminished.

We should note that while it plays an important role in the system, Social Pragmatics is limited by the fact that it makes no use of contextual semantic information; its activity is governed entirely by static rules (implemented in Drools) that are not informed by the current state of the Social Simulation Engine. Additional signal processing – within the ABL AI code – handles disambiguation of Social Pragmatics' output based on the dynamic social state of the running system. (Social Pragmatics does allow for – static – differences between agents; for example, some agents might understand more English than others.)

4.2.3 MiBA Signal Visualization

In the course of analyzing signals output from the MiBA system (for the purpose of adjusting the Social Pragmatics rules) it became clear that visualization of the data stream is critical given the volume and nature of the data. We developed a Javascript graphing tool built on amCharts to serve that purpose. Figure 11 shows what the visualization looks like in a static screenshot, but its real value comes from its flexibility and interactivity: data from an entire session can be imported in seconds; specific signals can be toggled; the selection region and zoom is easy to adjust using the slider and handles presenting the timeline at the top; and mousing over any point on any of the signal traces shows the precise value(s) at that point.

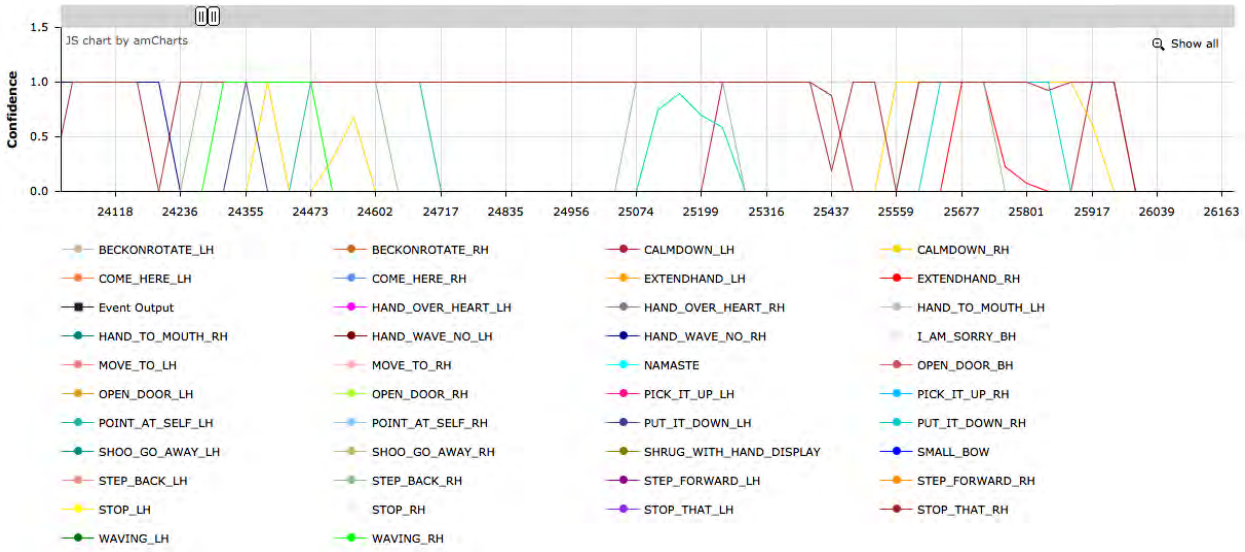

Figure 11: MiBA Signal Visualizer

4.2.4 Social Simulation Engine and Performance AI

These two companion components are implemented primarily in ABL, an agent-oriented language that compiles to Java. They accept social signals and the state of the virtual world, and reason over possible actions for virtual characters to take. When faced with a pedagogically significant choice, some configurations of the Social Simulation Engine pass action options to the Pedagogical Director (implemented by SoarTech in Java – see Section 4.2.7), which communicates its choice back to the Social Simulation Engine.

The choices made by these two components bottom out into animation acts, which the Performance AI module sends to the virtual world simulator.

For further discussion about the activity of this component, see Section 5: Expressive Artificial Intelligence for Social Immersion.

4.2.5 Virtual World Simulator

A custom mechanism built with Unity – a highly flexible, general-purpose 3D game engine – renders all of the audio and video that IMMERSE end users actually experience.

A socket-based bridge connects Unity to the Performance AI module and transacts using sets of name-value pairs that describe commands going into Unity and events coming out of it. The API that this bridge implements (in C# on the Unity side) provides significant power and flexibility to the Performance AI code that drives it. Highlights include support for layered, body-part-specific animation (including a multi-layered facial animation mechanism), audio playback, dynamic VC gaze tracking, and VC locomotion and object manipulation.

Inverse kinematics (IK) is used for several features in the virtual world simulation: controlling character gaze, pointing, and interaction with objects. Character gaze uses Unity's built-in IK system, with a fairly broad support framework built on top of it. Unity's IK system positions characters correctly for looking at particular points in a given moment, while the support framework uses this to allow characters to smoothly transition between looking at different things, focus on different targets with their head and eyes, and so forth. Final IK, a Unity plugin,

is used to handle pointing, and object interaction. When a character is properly rigged with Final IK components, pointing can be controlled (and transitioned in and out) in much the same way as with the built in Unity IK system – but with a more advanced, more realistic constraint solver.

Object interaction is a little more complex. Each object that can be interacted with (picked up, opened, etc.) has a component describing the correct body position and animation curves required for the interaction. For example, the fruit in the fruit box have a model of the proper hand position for picking them up. This combines with a character-side component that smooths out animations, handles updating of inventories, and so forth, to allow each VC to interact with the environment in a number of different ways.

4.2.6 Models and Assets

BBN subcontractor Fire Hose Games produced the visual assets in IMMERSE.

BBN, UCSC, and Fire Hose worked together in a phased and iterative process to design and develop the virtual characters, and the settings in which the various scenarios occur. This began at the start of the program, with extensive and intensive discussion and prototyping to determine a level of realism appropriate to the task. On one hand, we did not want to aim for photorealism, both because of the Uncanny Valley effect (in which very-nearly-but-not-quite-real-looking characters produce a confused, disturbed, or even disgusted state in viewers) and because fidelity issues would make some of the more subtle virtual character expressions difficult for a user to perceive. On the other hand, we did not want to make a cartoon world; we knew our end users would require some realistic aspects if this were some day to become a full-fledged and effective training system. Ultimately, we embraced a balanced approach that incorporated enough realistic elements that the user could accept the world as an alternate reality (not a cartoon world) but enough exaggerated and simplified elements that we avoided the uncanny valley, and the expressions of the virtual characters were immediately clear.

When designing the sets, we made extensive use of real-world photographs and other source material; and produced (and iterated on) concept art, rough untextured geometry, and rough texturing on the way to producing the final scenes.

All character models and animations made use of the skinned animation mechanism provided by Unity (“Mecanim”) for everything including facial animation and lip synch but excluding some advanced Inverse Kinematics functionality, which is provided by a third-party library (See Section 4.2.5, above).

Because we opted to provide the Performance AI module with maximum control over the animation system, we made minimal use of the Unity animation state machines that a game might typically use to control animation transitions. Instead, we established a database of all animation assets (implemented as an Excel spreadsheet) that specifies how each animation is to be used in terms of body parts and layering, that we then use to generate automatically the Java code describing the animations (used by ABL code) and the (rudimentary) state machines used by Unity to understand the animation assets and their usage.

4.2.7 Pedagogical Director

The Social Simulation Engine is integrated with the Pedagogic Director (PD), developed by SOAR Technologies, another TA-2 performer. The PD has an important role in tracking learner performance over time against a collection of learning objectives. And, in any given scenario run-through, it can set initial conditions and moderate the activities of VCs and the coach, though

a pedagogical policy that attempts to balance three competing goals: social scores (the social simulation engine's prioritization of available social moves), learning objectives (for example, focusing on unmet learning objectives), and variability (exposing the learner to unfamiliar circumstances).

As described in detail in Section 5,Expressive Artificial Intelligence for Social Immersion, the social simulation engine repeatedly generates a ranked list of social moves and their associated Social Interaction Unit (SIUs). Each list of proposed SIUs is sent to the PD for consideration. Each SUI option includes metadata describing the initiator and responder of the activity, and a set of learning objectives impacted by the SIU. The learning objectives include immediate and future learning objectives. Future learning objectives allow the PD to factor the anticipated consequences of critical junctures into its decision-making. SIUs generated by the social coach – proposing instructional interventions – were likewise passed along to the PD for adjudication. The learning objectives were drawn from the findings of the TA-1 and TA-1B program activities.

For additional discussion regarding the Pedagogic Director, and coaching and pedagogy generally, see Section 6, Social Pedagogy.

4.3 Infrastructure

4.3.1 System Hardware

Typical IMMERSE installations includes the following hardware components:

- 70" Television (Sharp LC-70LE650U)
- Television Stand (TVSTN80)
- Kinect for Windows v2
- Microphone Assembly (Shure BLX88, BLX1, PGA31)
- MiBA Workstation (AlienWare Aurora R4)
- Simulator Workstation (AlienWare Aurora R4)
- Network Switch (Linksys SE2800)

The two workstations communicate over a local network that includes nothing more than those two machines (no external network connection is required).

4.3.2 Software Repositories

At the highest level of organization, the IMMERSE software makes use of three different software repositories: an SVN repository ("live-build") containing the latest stable interoperating binaries from all performers (as well as various test branches) and two Git repositories ("ssim" and "ssim-unity") for the main system framework (including all ABL AI code) and the Unity project, respectively. The remainder of this section focuses on the system framework contained in the "ssim" repository.

4.3.3 Processes and Interprocess Communications

As shown in the High-Level Data Flow Diagram (Figure 12), IMMERSE is composed of four processes. (The three external to the core framework are shown in red.)

The Social Simulation and Unity processes are generally run on the same workstation due to the tightly coupled and high-velocity nature of their transactions, which are structured as sets of

simple name-value pairs. MiBA is run on a dedicated workstation (given its processing requirements) and is controlled via a small Remote Launcher application (designed to run at startup) that exposes MiBA as a service, so that users never have to do anything with the MiBA workstation except start it up and shut it down.

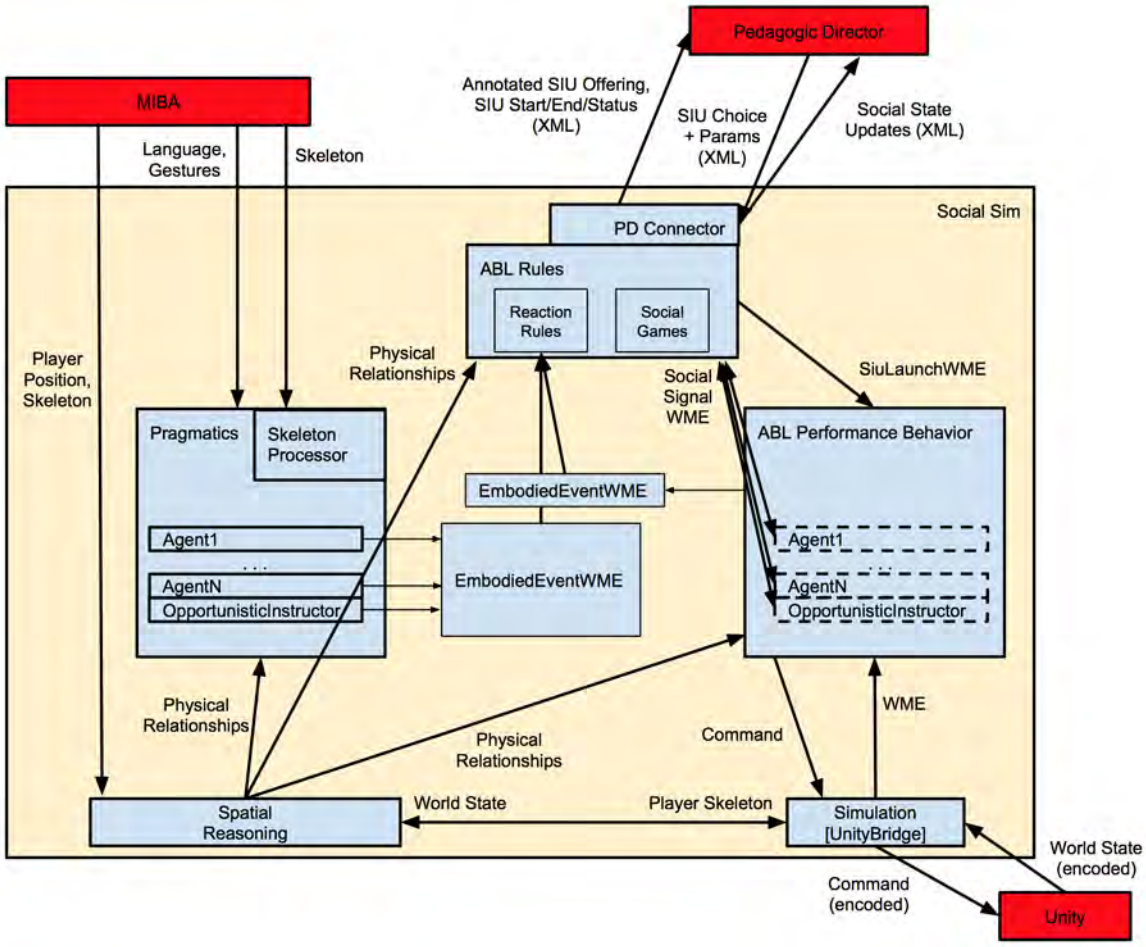

Figure 12: High-Level Data Flow Diagram

Transactions with MiBA are encoded as XML, and conducted over sockets. Because much of the streamed data MiBA provides is effectively binary, we require careful use of explicit schemas (encoded as XSD) – and, we use these schemas to generate the Java code representing the structure of the MiBA streams. (MiBA also exposes a REpresentational State Transfer (REST) interface that the system uses for high-level state management during initialization and calibration.)

Although the Pedagogic Director initially used an XML-over-sockets interface, it eventually became a service, with which the Social Simulation communicates over a REST interface when the PD is in use. (The PD is designed to run on a dedicated server that is shared across multiple applications.)

4.3.4 System Framework and Execution

The IMMERSE software framework is implemented in Java, using the Spring Framework in a lightweight way to organize the various software objects ("beans", in the Spring Framework

terminology – in Java they are simply classes, with no special designation except that they are referenced in Spring configuration files – see AblBridge/resource/spring) into various launch configurations. Optional configuration elements include the Unity process launcher (which is disabled in some configurations to allow for the use of the Unity Editor, which launches the Unity process independently) and the MiBA GUI Server element, which provides a GUI-based implementation of the MiBA system, for use in development environments that do not have the full MiBA system installed. Another configuration variation involves different flavors of the Pedagogic Director (REST-based, socket-based, trivial, none). All launch configurations start with the SpringMain class, which loads low-level properties files ([config, site, user].properties) and then loads one or more XML files describing the set of beans to include in the current configuration (and how they are connected to each other).

The Spring Bean Dependency Graph (Figure 13) shows the core set of beans that are included in all configurations. Highlights include the three client beans that read data from MiBA and implement Social Pragmatics; the simulation bean that transacts with the Unity process; the localizer bean that monitors all agents and performs spatial reasoning; and the ablManager bean that initializes and provides an interface to the ABL runtime.

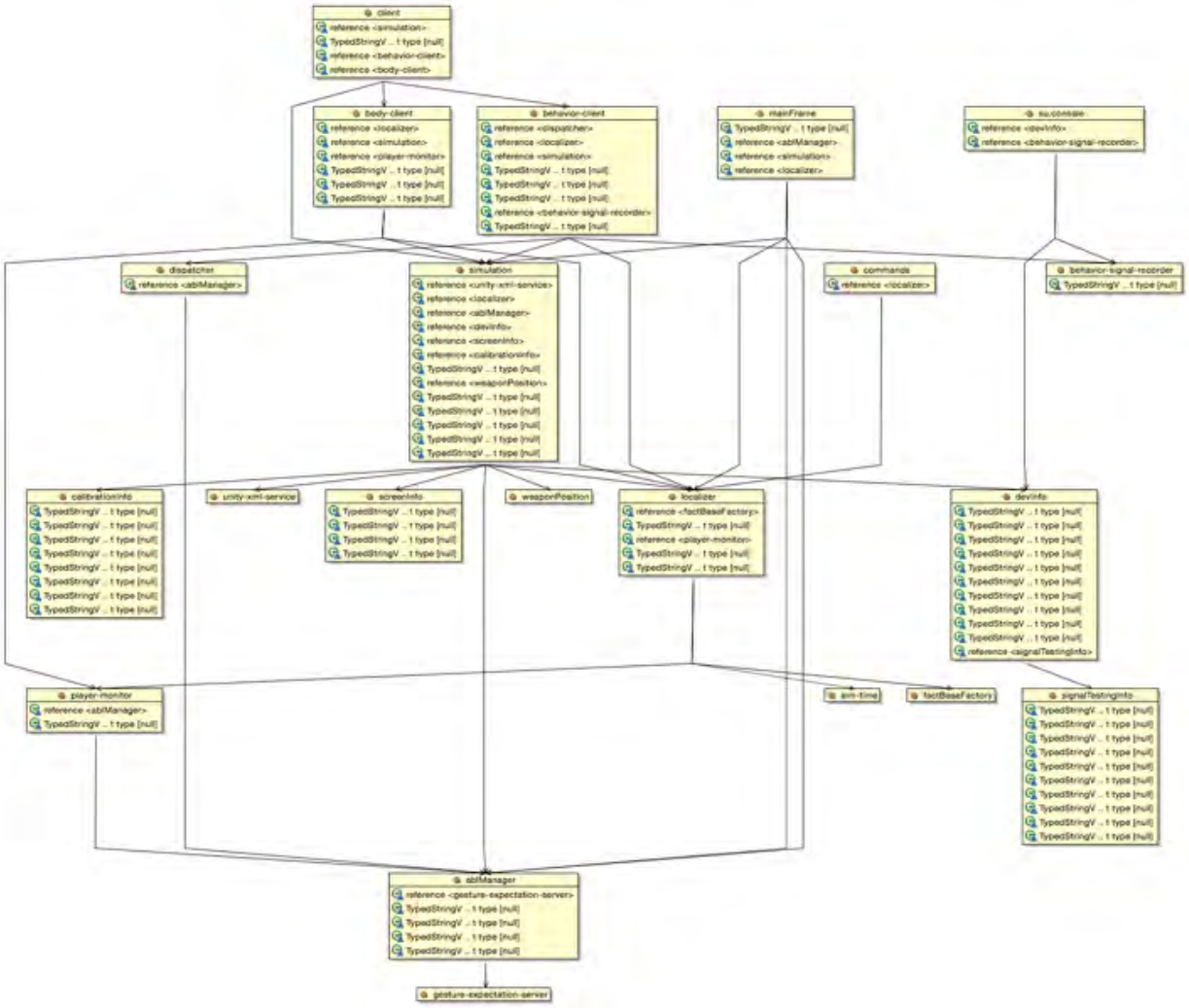

Figure 13: Spring Bean Dependency Graph

5. Expressive Artificial Intelligence for Social Immersion

This section describes the technology we have developed for supporting unscripted social interaction with virtual characters. Although people generally treat social competence as a basic/implicit skill, it is difficult to achieve with virtual characters for several reasons. First, social phenomena are inherently complex and require sophisticated mechanisms to express in automated form. In addition, there is a gap between computational models and social science theory, as no one has attempted to transform the types of behavioral analyses available from the social sciences into generative models that can drive synthetic characters. Our approach attempts to bridge this gap by providing virtual characters with a social agenda. In particular, we take inspiration from Berne (1966) and Goffman (1974), and enable non-scripted interactions with virtual characters by pursuing the metaphor of social games.

In more detail, we define a social game as a family of practices surrounding particular elements of social state, and associate social motivations, moves, and preference logic with each game, together with a body of executable behaviors that implement those moves. Our architecture for utilizing social games models intent formation by selecting character motivations appropriate to the situation, and resolving them through social moves into behavior. It selects character behaviors in response to player input through similar preference reasoning. The underlying behaviors execute in a virtual world that supports real-time, whole-body player interaction.

The behaviors that drive character action constitute a major body of work. At an abstract level, they provide the standard functions of a reactive computational agent that senses, thinks, acts on and reacts to the world. However, our context imposes two additional constraints: 1) the behaviors must represent social functions, and 2) they must generate expressive, believable performances if the player is to engage socially with the characters at all. These constraints structure our performance system. The characters sense the world by interpreting player input in social terms, they represent plans as compositions of short social interactions that respond to player input, and we have put a great deal of effort into the small behavioral nuances that communicate character affect, attention, and social intent. More broadly, our goal of supporting non-scripted social interaction has led us to a generative model, where the characters freshly choose behavior in response to each successive player signal and their own internal motivations, rather than select actions out of a tightly controlled script. As a result, each interaction with the player is different, and each scenario has an emergent flow (within the sphere of interactions supported by social games).

The following material describes our approach to social simulation. We divide that discussion into sections on Social Games, covering intent formation, social response, and composition of social games, and Believable Performance, which examines social perception, expressing social interaction, performance guidance, and the mechanism for interleaving performances. The underlying implementation language (ABL) supports hierarchical, parallel, and reactive agent programs, using the metaphor of dynamic behavior trees. It is described in Mateas and Stern (2002).

5.1 Social Games

A social game is a family of practices surrounding social state. We have defined three social games, Alliance, Authority, and Threat, and have employed them in multiple scenarios. The Alliance game deals with forging and damaging relationships, while Authority concerns power dynamics and ownership over objects and space. Threat deals with the management of physical

force and danger. Each game monitors certain elements of state, and contains representations of relevant social motivations and abstract social actions called moves, together with rules for prioritizing them.

Figure 14 illustrates the architecture for executing social games. It consists of a memory (for holding background knowledge, observations, and inferred beliefs), an intention formation process for selecting motivations and moves for characters across games, and a performance mechanism for executing and interleaving the associated behaviors. We discuss social game content (state, motivations, moves, and ranking rules) and the process of utilizing games to select social moves, below.

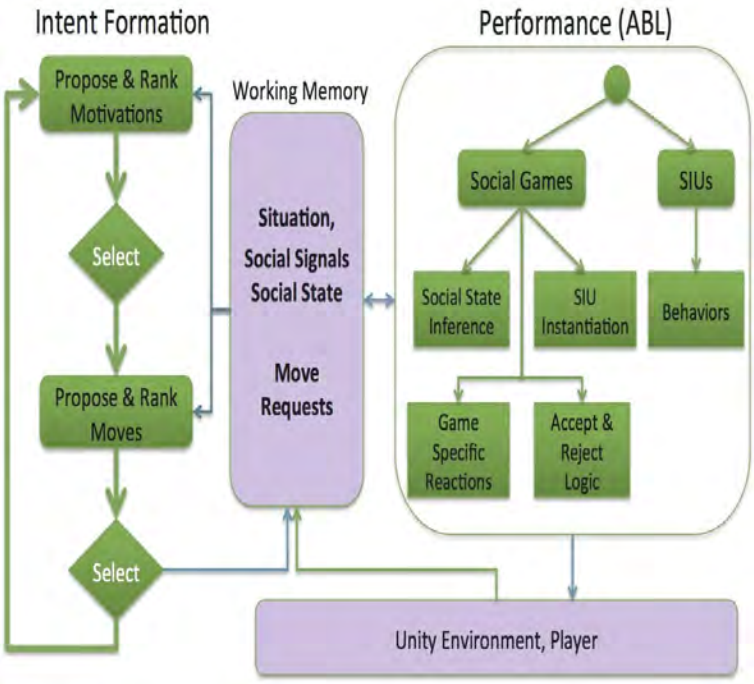

Figure 14: The Architecture for Social Games

We represent the social game state via binary predicates or continuously valued relations. For example, the Alliance game monitors a degree of alliance (a scalar-valued directed relation between two VCs, or the VC and the player), and a binary predicate encoding whether those agents are allies. Each social game also contains a characteristic set of motivations to create (increase) or remove (decrease) that state, as well as to express its value through agent actions in the virtual world. The Alliance game supports AllianceUp, AllianceDown, and AllianceExpress relative to the degree of alliance, and AlliesMake, AlliesBreak, and AlliesExpress relative to the allies distinction. The moves within a social game represent abstract actions for pursuing motivations. In general, there are multiple moves for each motivation. For example, Greet and GiveAGift address AllianceUp, while BackupAlly and FriendlyGoodbye address AllianceExpress.

As a second example, the Authority game governs interactions related to power dynamics and ownership over objects and spaces. The underlying state consists of AuthorityOver(X,Y, val) relations, and permission levels for access to objects ranging from “no access” (0) to “can consume/destroy” (5). The motivations are AuthorityUp, AuthorityDown, AuthorityExpress.

The Authority game contains a wide variety of moves for the house search scenario. These include MessWithOthersStuff, OpenYourCabinets, EatOthersStuff, HoardMyStuff, Outburst, PutMyStuffDown, GiveMyStuffBack, DirtyLook, and DerisiveChuckle.

5.1.1 Intention Formation

Each social game contains a set of preference rules for ranking motivations and moves. For example, the following rules simultaneously nominate and rank motivations:

1) Alliance(X, Y, <50) → AllianceUp(X,Y) + 2
2) Alliance(X, Y, >50) ^ Alliance(Y, Z, >50) ^ Alliance(X, Z, <50) → AllianceUp(X,Z) + 3

The first rule acts to elevate the importance (called volition) of increasing the degree of alliance between two characters whose bond is suffering. The second motivates a character to build networks of alliances. X observes that he is friendly with Y but not Z and Y is friendly to Z, so X reaches out to Z.

Similarly, the Authority game contains these two rules:

1) Arrogant(X) ^ Authority(Y,X,<50 ^ Authority(X,Y,<80) → AuthorityUp(X,Y) + 6
2) Permission(X, Obj, Owns) ^ Permission(Y, Obj, LookAt) ^ Touch(Y, Obj) → AuthorityUp(X,Y) + 8

The first expresses an inclination for one character to dominate another, while the second expresses a desire to reassert authority when a character exceeds its allowed permission to manipulate an object.

An analogous set of preference rules govern moves. For example:

1) AllianceUp(X,Y) ^GiftingAppropriate(X,Y) ^ Object(tag==“gift”, Obj) → GiveAGift(X, Y, Obj) + 5
2) AuthorityUp(X, Y) ^ Permission(Y, Obj, Owns) ^ Permission(X, Obj, <Touch) → ViolateObjNorm(X, Obj) + 7

These rules simultaneously nominate and rank moves. The first suggests X give an appropriate object to Y as means of increasing the degree of alliance between those two characters. The second rule incites X to deliberately exceed permission levels with respect to Y’s belongings in a bid to increase authority.

In general, social games contain a large number of rules for ranking motivations and moves, and these rules can depend upon accumulated knowledge, character status, and current environmental state. For example, GiftingAppropriate(X, Y) only becomes true after characters have greeted one another, and the environment must contain objects tagged as giftable for the GiveAGift rule to apply. Similarly, only characters flagged as Arrogant seek to dominate others within the Authority game.

Volition values add across rules. For example, in the Breaking Bread scenario, the player and Local National Soldier (LNS) begin with an Alliance, so if the player and Head of Household (HoH) become allies, the motivation rules for AllianceUp (above) combine to influence the HoH to increase his alliance with the LNS, and vice versa. However, the AuthorityUp motivations have higher volition; the LNS will care more about dominating the HoH, and the HoH more

about increasing his authority over the LNS in response to his prior bad behavior. Taken together, the rules that assign volition to motivations and moves represent an agent-held utility function. Their additive semantics mediate situation specific influences, while the specific volition values (large or small) follow authoring conventions.

The intention formation process utilizes this form of preference logic to search the space of situation relevant motivations and moves. The current model proceeds top-down, via the following steps:

1. It determines volition values for all relevant character motivations.
2. It selects the top two motivations for each character whose volition score is above a pre-specified threshold.
3. It determines the volition values for all moves relevant to those motivations.
4. It selects the best move for each character whose volition score is above a pre-specified threshold.
5. It passes the resulting moves (if any) to the performance system for execution (see Section 5.2 on Believable Performance).

Intention formation occurs on a regular clock - the characters experience a decision opportunity once per second. In addition to reasoning about authority, alliance, and threat state, the logic includes some rules about general social interaction. For example, characters are more prone to action if they have done nothing for a time, and they won't repeat recent moves or launch moves currently underway.

The final phase of intention formation borders on performance concerns, as it acts to parameterize the executable behaviors corresponding to moves. This reasoning annotates actions by their urgency (some intentions form in response to events, and must be executed quickly to read well), or by the affect the character should display while executing the move. The mechanism is similar; it employs rules that respond to social events and character properties.

5.1.2 Social Response

In addition to taking autonomous action, characters must respond to player input. This often leads to situations where the characters must weigh alternatives. For example, when the player in "Finding Farah" holds a photo up to the VC as if to say, "Have you seen this person?", the VC experiences a choice between answering, refusing to answer, and turning to another VC for advice. The social response logic generates these alternatives, assigns them volition scores, and selects the best alternative to pursue. It runs in response to a social signal encoding the event that the player has asked a question.

The mechanism is similar to top-down intention formation, although we separate the processes of nominating and ranking options:

```
// Nominate responses, search over entityMem, bind over socSigMem, assert into responseMem
subgoal nominate(nominate_decisionRequestAnswer, entityMem, socSigMem, responseMem)

// Score the nominated responses
subgoal score(score_decisionRequestAnswer, responseMem);

// The result is the highest ranked response
result = pickBest(responseMem);
```

This pseudocode is very close to the original. The nomination rules generate response options like basic acceptance and rejection, along with more nuanced replies such as reluctantly complying or looking to another character for guidance. These rules impose hard constraints; they identify responses which are both relevant and feasible given the parameters of the question and the state of the world. For example, the option to warily reject a stranger's request will only be nominated if the decider is wary and the asker is a stranger, as shown below:

```
rule nominate_rejectStrangerIfWary {

    // find a social signal record capturing the question, and bind asker and decider from it
    (SocialSignalWME sender::asker recipient::decider)

    // Require the asker to be a stranger to the decider
    (CharRelationship c1==decider c2==asker type==Relationship.STRANGER)

    // The decider must be wary
    (CharTrait c1==decider type==Trait.WARY)

    ->

    // create a performance request
    (PerformanceRequestWME
            siu = SIUs.RefuseToAnswer
            char1 = decider
            char2 = asker
            perfDirection=PerformanceDirection.ANGRY)

}
```

Once options are nominated, a second set of rules assigns preference scores. These rules express soft constraints. They add volition to a given option based on the traits of the asker and decider, as well as the state of the world and history of past events. For example, a character will be more likely to answer the question if asked by someone with authority over them, or if they've shared food with the asker. On the other hand, they'll be less likely to answer if they're wary and the asker is a stranger.

Once scoring is complete, the system selects the highest-ranked option and the corresponding performance variation executes for the character.

While the current implementation employs calls to nominate, score, and select operation to invoke the appropriate rulesets, we have recently added a language construct that makes these calls implicit:

```
with (policy policy_decisionRequestAnswer) choose {
        subgoal siu_refuseToAnswer(decider, asker, PerformanceDirection.DEFAULT);
        subgoal siu_agreeToAnswer(decider, asker, PerformanceDirection.DEFAULT);
        subgoal siu_refuseToAnswer(decider, asker, PerformanceDirection.ANGRY);
}
```

In this configuration, the scoring rules in the decisionRequestAnswer ruleset match onto annotations associated with the action options, which can be static or dynamically generated at run-time. This form also replaces the use of performanceRequests with subgoal calls to the executable code that implements those performances.

Finally, although the system currently selects social responses based on features of the environment and of the specific action options, the reasoning mechanism can access the

character's motivations and associated volition scores. This would allow the character's choice (above) between a positive response and an angry refusal to be influenced, for example, by the importance of building an alliance with the person (or VC) asking the question.

5.1.3 Composing Social Games

Taken in isolation, each social game captures a family of practices surrounding a common theme. However, taken together, the games form a weakly interacting set. Social games couple through social state; the execution of an SIU motivated by one game may impact the state utilized in another to nominate and rank motivations or moves. Moreover, social games can be activated in in arbitrary combinations, so as the games are composed, more interactions are exposed, resulting in a form of emergent social behavior. This section describes that interaction space, first graphically and then in terms of the resulting behavior.

As mentioned earlier, we utilized three social games in Breaking Bread, and provided detail on Alliance and Authority. The third game, Threat, concerns the management of physical force and danger. Threat tracks two key elements of state: Might, and PerceivedDanger. Might represents a character's level of power (e.g., is it armed or unarmed), while PerceivedDanger captures both the likelihood and the magnitude of the force that others characters could apply if a conflict arises. The Threat game contains the standard three motivations, Threat_Up, Threat_Down, and Threat_Express, plus moves for ProtectSelf, GetHelpWithOutburster, HelpMeOut, AdvanceOn, WardThreat and AcknowledgeThreat. It also contains multiple rules for ranking Threat motivations and moves.

Figure 15 provides a graphical illustration of the interaction space enabled by the Alliance, Authority, and Threat games. This diagram elides some of elements of state, motivations and moves, and only shows relational terms (suppressing arguments) in order to highlight the coupling between games. The top row of the figure lists elements of social state input to the intention formation process. The second row (boxed, with graduated shading) identifies motivations the characters can choose. The next four rows name moves that address motivations, while the bottom row shows state altered by the execution of moves. The figure also sorts the elements from left to right by social game, in the order of Alliance (in purple), Authority (green), and Threat (pink). The arrows show data flow imposed by nomination and ranking rules, or by execution of the SIUs associated with moves. More exactly, the arrows show the aggregate of the data flow across all rules (meaning a fan-in may represent multiple rules).

An important note about the figure is that the data flow stays mostly in columns; Threat state flows through Threat motivations, into Threat moves and back to state. For example, PerceivedDanger effects the importance of ThreatDown, which impacts the volition to ProtectSelf. Execution of ProtectSelf may alter the character's Might and PerceivedDanger, depending upon how it unfolds in the world. (There is no guarantee; the SIU for ProtectSelf contains alternate methods, the situation enables some paths, and the player can impact the outcomes.)

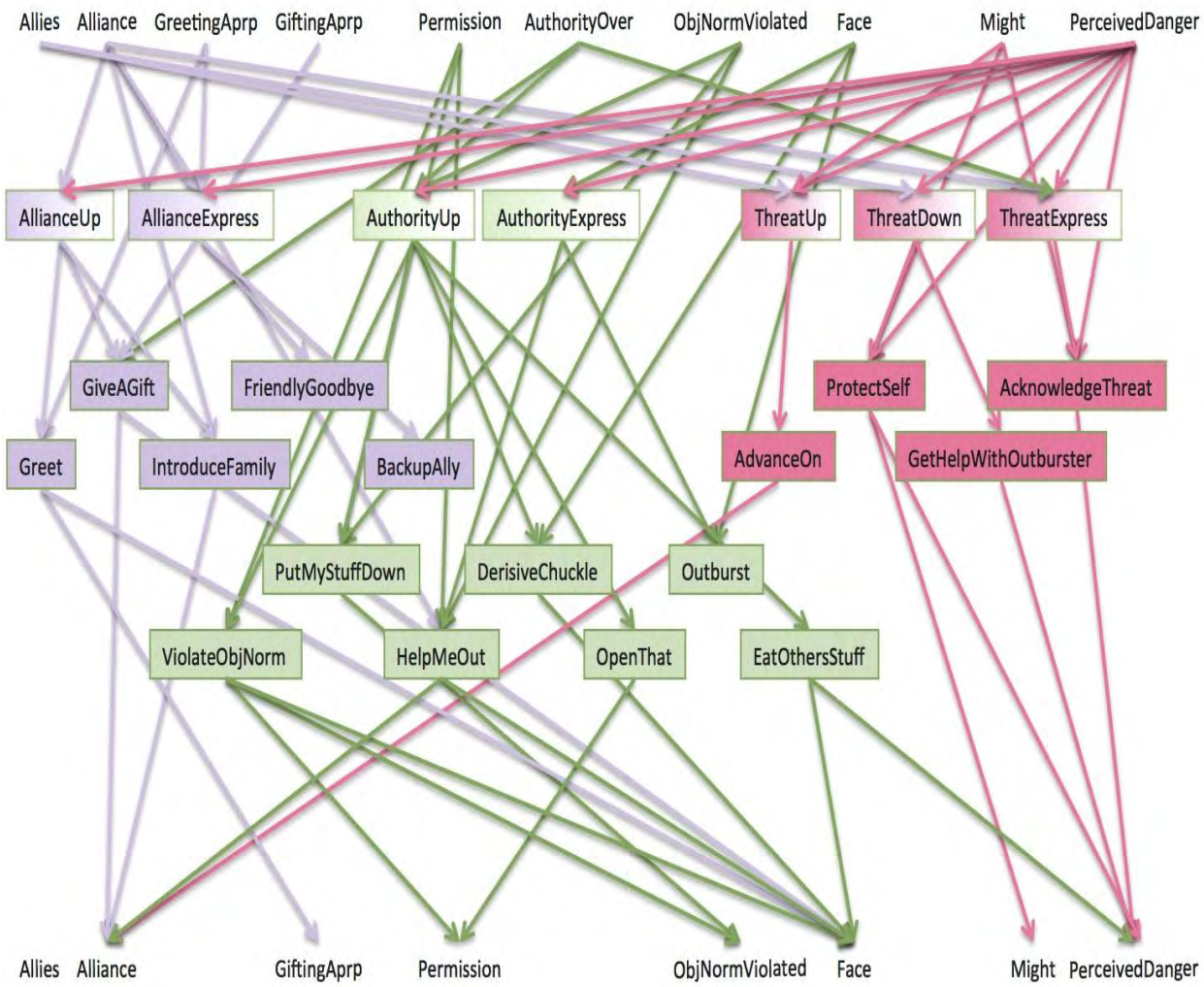

Figure 15: Social Games Composition

The diagram also contains multiple instances of cross-talk. At the motivational layer, PerceivedDanger decreases the volition of motivations in all other games (as a means of highlighting the relevance of a threat, no matter its severity). If a character has Alliances, their presence tends to decrease the importance of ThreatDown (to counter perceived danger). A character with an Alliance to an authority figure looks to that figure for support via ThreatExpress (as the LNS does to the player in response to the HoH's outburst in Breaking Bread). While moves are almost wholly owned by games, some rules employ state from the Authority game called AuthorityOver to nominate and assign volition to GiveAGift.

Similarly, Alliance levels are relevant to HelpMeOut. The cross-talk from moves to state is more profound. Within the Alliance game, completing social rituals (via GiveAGift or Greet) impacts Face in the Authority game. Within Authority, requesting others to HelpMeOut builds Alliance with the helper, while EatOthersStuff impacts others' PerceivedDanger through the impression that the character is willing to take aggressive action (as seen between the LNS and the HoH in Breaking Bread). Similarly, the move to AdvanceOn a character within Threat clearly impacts any prior Alliance.

5.1.4 Layered Demonstrations of Social Games

Because social games only interact through shared state and soft constraints, no game is required to execute another. Moreover, social games can be activated in arbitrary combinations; a given combination defines a space of possible actions, and an agent can initiate any move in that space that is both motivated and feasible at any time. In order to demonstrate this point, we changed the context for executing social games to a "Sandbox" scenario where the interactions are more visible than in Breaking Bread. The Sandbox contains fewer elements; it supports interaction between a player, two non-player characters (VC01 and VC02), and a handful of objects on a pedestal. We illustrate social game composition through three, layered demonstrations, viewable online (Social Game Videos, 2014). The first generates behavior by Alliance, alone, while the next two add Authority and Threat in turn.

The interaction based solely on the Alliance game unfolds as follows. We give VC02 a positive Alliance value towards the player and mark the objects on the table as "giftable". After the player greets VC02 in a friendly manner, GiftingAppropriate is created between VC02 and the player. This Alliance state motivates a simple Alliance building move, GiveAGift, for VC02 to offer the player one of the objects from the pedestal.

The interaction generated by Alliance plus Authority follows a different path. We initialize the starting state required by the Authority game as follows VC01 is given ownership over the objects on the pedestal by setting Permission values for all the objects to the highest tier, 5, and "granted", the player and VC02 are assigned Permission values of 1 with the status "granted", (which enables them to freely "look at" objects in the environment), and the player is marked as having AuthorityOver VC02 and VC02 is given the character trait, Arrogant. When the scenario starts, the player greets VC01, and again triggers a friendly gift offer through the Alliance mechanics outline above. Meanwhile, AuthorityUp motivations coming from VC02's Arrogant trait make him touch items owned by VC01 without permission. VC02's actions trigger a permission update for that object to "ungranted, pick up". The first time this violation occurs, VC01 gives VC02 a DirtyLook, a move motivated by an AuthorityUp response to the object violation. When VC02 picks up the bread, this second ownership violation motivates a stronger AuthorityUp response. VC01 angrily asks VC02 to put down the bread (via RequestPutThatDown). VC02 refuses to comply (a local accept/reject decision), due to his Arrogant trait. Finally, because of previous alliance building through gifting and greeting, VC01 turns to the player and asks for help, an Authority move that is also sensitive to Alliance state. The player asks VC02 to stop his annoying behavior, and this time, VC02 complies (accepts) because the player has AuthorityOver relation with him. This move by the player raises his Alliance with VC01 but reduces VC02's Face.

Finally, adding the Threat game makes the fact that the player is holding a rifle salient. In this run-through, the player greets as before, but then rejects the offered gift, offending VC01 and failing to build Alliance. When the wrangling over objects starts, VC01 does not look to the player for assistance because of the lack of built up Alliance. Instead, he simply gets more and more upset, and continues to apply AuthorityUp moves in response to VC02's provocations. VC02's PerceivedDanger elevates due to VC01's yelling and he reacts with fear. He forms the motivation to Threat_Down, which triggers the move to ProtectSelf, causing VC02 to raise his hands in an attempt to surrender. When the player raises her weapon to take control of the situation, her Might and the resulting perceptions of danger motivate both VCs to ProtectSelf in response to Threat_Down, now orienting on the player.

5.2 Believable Performance

In order to support the project goal of training social interactions, our virtual characters need to perform with a degree of naturalness that invites social engagement. This requirement has demanded a level of attention to producing believable virtual characters that goes beyond what is common in research projects, and that has shaped both the mechanisms and the content we have embedded in the performance component of the Social Simulation Engine. Our context emphasize several aspects of this task: providing characters with a social presence, supporting unscripted real-time interaction, and maintaining character liveness in the course of up-close encounters.

In a bit more detail, giving characters a social presence requires methods for enabling social perception, expressing strategies for accomplishing social goals, and for communicating social signals, including affect. The need for unscripted real-time interaction implies that characters must handle interruptions while pursuing their own agendas, but more broadly, our goal is to give the player so much control over the interaction that its trajectory has an emergent flow. This stands in contrast to the scripted branch points and enforced transitions commonly available in games, and it has influenced us to express social strategies in a reactive coding style, and to represent them in terms of recombinable, interactive parts (called Social Interaction Units, or SIUs). The need for unscripted real-time interaction also implies that the characters experience unpredictable performance demands, e.g., to pay attention to a player's new gesture while performing a heated exchange with another VC. This issue led us to develop a performance management system charged with producing smooth interactions by allocating body resources to performance requests as they arrive. This framing of the problem is novel relative to the gaming industry. Finally, the goal of maintaining character liveness in the course of up-close encounters has influenced us to develop new techniques for modeling attention shift and split attention, as well as to adopt industry standard practices for communicating basic character liveness (e.g., layering in animations for breathing, idling, blinking, and other affective stance).

The following sections discuss our approaches to these problems in more detail. We discuss social perception, social interaction strategies, performance guidance (including expression of affect), performance management, and attention management in turn. We end with a brief discussion of the underlying agent-oriented programming language, called ABL.

5.2.1 Social Perception

The task of supporting character social perception requires surmounting an abstraction gap. The system needs to map a stream of physical gestures recognized by the MiBA front end, like "EXTEND HAND" and "POINT-AT" into social signals like "Request Answer" and "Request Go To" that enable appropriate action in context. This transformation requires addressing a number of issues common to sensor processing tasks such as regularizing noisy input, using expectations to resolve ambiguity in perception, and assigning meaning to observations given the character's current activities and physical context.

Figure 16 illustrates the Social Simulator's pipeline for social perception. It begins with primitive events recognized by the MiBA system from player input. A pre-processing phase (not shown) cleans this data by suppressing repeated and unstable signals, and augments it with a few skeletal motion features not native to MiBA. This results in a stream of Embodied Events capturing gestures, and recognized speech phrases, as well as a small set of prosodic features and

facial expressions. Table 1 lists the full set of primitive features utilized by the social simulator (which does not employ all signals generated by MiBA).

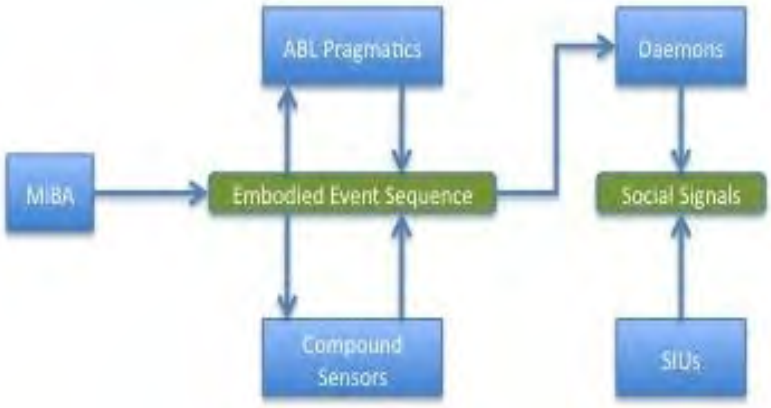

Figure 16: The Architecture for Social Perception.

Table 1. Primitive Embodied Events

BECKON	BOW	EXTEND_HAND	HAND_OVER_HEART	HAND_TO_MOUTH	HEAD_NOD
HEAD_SHAKE	LOOK_AT_HAND	POINT_AT_HAND	POINT_AT_SELF	POINT_TO_EYE	POINT_DOWN
POINT_UP	POINT_LEFT	POINT_RIGHT	POINT_AT_X	REQUEST_CALMDOWN	REQUEST_STEP_BACK
REQUEST_STOP	WAVE	FACE_HAPPY	FACE_FROWN	FACE_SURPRISED	VOCALICS_CALM
VOCALICS_EXCITED	START_GESTURING	END_GESTURING	START_SPEECH	END_SPEECH	GAZE
GAZE_PROLONGED	RUSH_FORWARD	UTTERANCE	YELL	USER_SKELETON_LOST	USER_FAR_AWAY

The subsequent stages of perception all apply context dependent transformations. ABL pragmatics reinterprets a single Embodied Event based on the character's current activities. For example, the rule:

```
rule EXTEND_HAND(player, recipient) {
        !(isOffering(recipient))
        (isOffering(otherVC))
        ->
        EXTEND_HAND(player, otherVC)
}
```

re-targets the player's EXTEND_HAND gesture to a VC who is offering the player an object at that moment. In contrast, Compound Sensors deduce new Embodied Events from sequences of Embodied Events over time. For example:

```
POINT_AT_HAND + POINT_TO_EYE + holding(player, photo) ->
COMPOUND_REQUEST_ANSWER
```

Here, the point at hand and the point to eye can be separated by a few seconds, while their merger into a single output signal tells the characters that the player is requesting information

about the photo. Table 2 lists the full set of Embodied Events output by these two categories of transformations.

Table 2: Embodied Events Generated By ABL Pragmatics and Compound Sensors

LOOK_AT_OBJECT_IN_HAND	POINT_AT_OBJECT_IN_HAND	PHYSICALLY_DISENGAGED	SOCIALLY_DISENGAGED
COMPOUND_BECKON	COMPOUND_USER_GONE	COMPOUND_REQUEST_ ANSWER	COMPOUND_REQUEST_ GO_TO
COMPOUND_REQUEST_ STEP_BACK	COMPOUND_POINT_AT_SELF _UNRECOGNIZED_SPEECH	COMPOUND_POINT_AT_ SELF_RECOGNIZED_ SPEECH	

Several of these events include parameters, e.g., that identify the recognized speech phrase, or the character asked to step back.

The next stage of perceptual processing maps Embodied Events into Social Signals that have direct consequences for VC action and social choice. For example, a daemon waiting on the Embodied Event,

COMPOUND_REQUEST_ANSWER(player, VC, Photo)

generates a requestAnswer Social Signal:

(SocialSignalWME type=Request value=Answer sender=player recipient=VC01 … parameters)

It also launches the Social Interaction Unit for requestOther_answer(player, VC01), which expresses and manages the corresponding performances. For example, requestOther_answer includes a daemon (one of many) that waits on the Request-Answer Social Signal, and reacts by phrasing a decision to answer the question, not answer, reluctantly comply, or look to another VC for guidance, as discussed in the section on Social Response (above).

Social Signals instrument action-oriented communications between the player and the virtual characters, but they also support social communications between VCs. For example, VC01 can post an EMOTION Social Signal indicating anger at VC02. That signal plays into VC02's choice of reactions. A given Social Signal is typically comprised of a social signal type (broad) and a value (specific). While some of these signals have function vs socially-oriented names, all feed into VC social choices and action. Table 3 gives the complete list of Social Signals types (excluding their values) utilized in the Finding Farah demonstration.

Table 3: Social Signals in Finding Farah

EMOTION	ENCOURAGE	OBJECT_TRANSACTION
OBJECT_SELF_USAGE	OBJECT_SHOW	REQUEST
RITUAL	THREATEN	SCENARIO_KNOWLEDGE

A final stage of social perception consists of daemons that monitor social signal transmission and induce changes to social state. Inferences of this form perform agent belief maintenance. For example, one daemon lowers alliance (player, VC01) in response to the Social Signal encoding VC01's Request-Refusal[1].

[1] To be precise, the value of *alliance(player, VC01)* represents the system's model of the player's perceived alliance with VC01. It may or may not correspond to the player's actual attitude.

5.2.2 Expressing Social Interaction

The performance side of the architecture in Figure 16 enacts social moves by executing social behaviors written in a special purpose, agent-oriented language. We have defined an intermediate vocabulary of these behaviors, called Social Interaction Units (SIUs) that share two organizing principles. They represent basic/minimal social transactions between individuals, analogous to beats in Façade (Mateas & Stern, 2005) or social exchanges in Prom Week (McCoy et al., 2013). SIUs are also short; they control character interactions with each other, or the player, for at most 1 - 10 seconds.

SIUs also share a common structure because they represent interactions between characters. As a result, each SIU consists of two parallel parts that describe the behavior of the initiator and responder of that interaction. For example, Table 4 illustrates the top-level structure of the SIU to request another agent to show an object.

Table 4: Parallel Structure of the Request Other Show Object SIU

VC Initiator	VC Responder
Animation: Point to object Speak dialog context: *"What do you have in your hand there?"*	Animation: Look at requester

Here, the initiator acts while the responder pays attention or otherwise bides time (a pattern that repeats across many SIUs). While this table illustrates an interaction between two VCs, the initiator or responder could be the player. For example, if the player is the initiator, the corresponding pseudocode (Table 5) looks for a social signal created by the player's action via the social perception pipeline.

Table 5: Structure of the Request Show Object SIU when the Player is the Initiator

Player Initiator	VC Responder
Wait for Request Object_Show Social Signal Absorb (delete) that player signal	Animation: Look at requester

Every SIU that involves a player and a VC has an analogous structure. When the initiator or responder is a VC, the code causes VC action, and when that role is fulfilled by the player, the code recognizes (and generally consumes) the corresponding Social Signal (if any).

The Show Object SIU in Table 6 provides a slightly more elaborate illustration of this symmetric encoding. Here, a VC can fulfill either role, while the player can fulfill at most one. This example corresponds to the case where the responder complies with the request to show the object (the SIU contains another case that performs a refusal).

Table 6: Symmetric Encoding of the Comply Case within the Show Object SIU

VC Initiator	VC Responder
Walk to / turn to responder (showee) Initially show the object Animation: Object-specific show gesture Speak dialog context: *"Here it is, take a look."* Keep showing the object Animation: Object-specific show gesture loop	Initial alert glance at initiator's (shower's) shown object Animation: Alert noticing posture, Walk to responder (if needed) Head tracking: Shower's shown object Facial expression: Shocked, then Stony Stop speaking (go silent) for a moment, then Speak dialog context: *"Hmm."*

	Glance between initiator (shower) and shower's shown object Animation: Alert noticing posture Head tracking: Alternate between shower and shower's shown object
Player Initiator	Player Responder
Wait for Object_Show Social Signal Absorb (delete) that player signal	No Social Signal, nothing to do

In general, the internal structure of an SIU branches on the initiator and responder roles, the player and VC role-fillers, and on alternatives where the responder accepts or rejects the initiator's action. Each of these units guide VC behavior for 1-10 seconds, while the sequence of SIUs is driven by player action (see the section on Social Response) or by the top-down motivation chain initiated by Social Games (see the section on Intention Formation). This results in a form of emergent flow, and unscripted social interaction (within the bounds of the interactions enabled by SIUs).

SIUs also support two forms of meta control. A time-out identifies the maximum elapsed time that an SIU can remain inactive before it aborts. This can occur either because it is waiting on a player signal that never arrives, or it has been suspended by a higher priority performance that claims its required resources. A gist point identifies a moment in the execution of an SIU where its purpose has been sufficiently addressed and communicated to the user. Any SIU that fails to reach its gist point will be retried, from its start, if it is suspended and resumed. In contrast, and SIU that has passed its gist point will be considered complete, and not retried. Time-outs and gist points are both author controlled annotations.

SIUs also have a hierarchical structure that implements a form of functional backchaining. For example, the SIU AcquireObject (pick up an object) is called by the following SIUs:

- ObjectTransaction: for a VC to give an object to another VC, they may need to acquire it first
- EatObject: for a VC to eat an object, it may need to acquire it first (if not already held)
- HoardObject: for a VC to hoard (collect) an object, it may need to acquire it first (if not already held)
- Outburst: to express emotional outrage, a VC may want to acquire an object, to throw/smash it

The RequestOther SIU subgoals social purposes, as it is composed of two SIUs called in sequence:

- InitiateRequest
- ComplyWithRequest or NotComplyWithRequest

Similarly, ObjectTransaction employs RequestOther, and several additional SIUs. This results in the following subgoal structure:

- ObjectTransaction
  - RequestOther (if a request phase is needed in this transaction)
    - InitiateRequest
    - ComplyWithRequest or NotComplyWithRequest
  - AcquireObject

- ExchangeObject
  - OfferObject
  - TakeOfferedObject
- PutDownObject (optional) or EatObject (optional)

Table 7 lists the full suite of SIUs in the Finding Farah demonstration:

Table 7: SIUs in Finding Farah

AcquireObject Approach Approached BriefAttention BriefChat Confused DigestMajorMove EatObject EnterRoom ExchangeObject Farewell GazedAt GetAttention GoTo Greet GroupFormation HoardObject	IntroduceByName Leave LookForSupport Mirror MirrorVocalics NoticeThreat ObjectTransaction OfferObject Outburst PersonalSpace PlayerPicksUpObject PointAtHeldObject ProtectOther PutDownObject Question Question_AnswerQuestion Question_ReactToQuestion	ReactToRushedAt ReactToYell RejectOfferedObject RequestOther RequestOther_AboutAnother_Attention RequestOther_AboutAnother_StopThat RequestOther_Answer RequestOther_CalmDown RequestOther_EatObject RequestOther_ExchangeObject RequestOther_GoAway RequestOther_GoTo RequestOther_PacifyTouch RequestOther_PutObjectDown RequestOther_ShowObject RequestOther_StepBack RequestOther_StopThat	RifleAim RifleLower RifleReady ScaredThreatened ShowObject StudyOwnObject TakeOfferedObject Thanks ThrowObject VentEmotion Wander WatchOthers WhatsUp

5.2.3 Performance Guidance

There are many ways to perform a given SIU that corresponds to a social move. Beyond setting options specific to the SIU, we would like to parameterize performances in a general way by applying character affect to texture a performance. This desire relates to an issue in authoring; rather than encode n^2 versions of SIUs that capture all combinations of action and affect, we have developed two decompositional strategies.

The first is to define a vocabulary of affect-related performance directives and require each SIU author to produce variants that express at least a subset of that vocabulary. For example, we employ the following directives in “Finding Farah”:

- SIU AcquireObject
  - PerformanceDirection.ANGRY will cause the SIU performance to use an angry swipe action to pick up an object, used in Breaking Bread when the HoH was going to pick up a bowl and smash it during an Outburst SIU.
- SIU AnswerQuestion
  - When social games decide how a VC will answer a question from the player (e.g., “where is the person in this photo”) they specify a performance direction encoding the tone to employ when answering the question:
    - PerformanceDirection.WARY is used if the AuthorityGame decided the VC felt affronted by the questioner,, causing the answerer to speak in a halted tone, with stony facial expression, with minimal energy
    - PerformanceDirection.RELUCTANT is used if the AllianceGame decided not enough

rapport was built up, and the answerer looks nervous, stammers, and doesn't actually answer the question

- PerformanceDirection.FRIENDLY is used if the AllianceGame decided enough rapport was built up, causing the answerer to smile, speak in an upbeat tone, and gesture and point excitedly

The wrap-on mechanism provides a novel, and more general approach to the problem of encoding affect independent of action. It operates by layering expressions of attitude onto behavior. In more detail, we author the core functionality of each SIU in an affect-neutral way, comprised of very short functional performances. For example, ExchangeObject has the initiator holding out the object, waiting for the responder to reach for it, which finally completes the exchange. Next, we write behaviors that can perform these low-level actions with a variety of attitudes. This can be as simple as defining attitudinal variations of individual animations, such as holding out an object in a friendly, aggressive or hesitant way. The wrap-on manager acts by inserting these animations before, after, and/or in place of the core performance, such as impatient sighs, frustrated gestures, or nervous glances. The implementation employs what are called "meta-behaviors" in ABL; behaviors that inspect and alter the activities in the current behavioral tree.

We have implemented a number of wrap-ons for expressing character attitudes. Characters can be hostile, suspicious, friendly, sympathetic, frustrated, happy, and nervous, and these attitudes can each be applied to multiple SIUs. More exactly, the object of a wrap-on is a fine-grained behavior within an SIU that invokes an animation, specified by its class. Each {wrap-on, behavior} pair has multiple realizations, expressed by insertions of a preamble step, a postlude, and/or a specific instantiation of the animation class. For example, a hostile instance of returning the picture could involve a pause (preamble), a rapid extension of the hand (the instantiation), and a shake (postlude), or a cough, a sneer plus a slow extension, and a rapid retraction of the hand in sequence. Wrap-ons apply to behavior instances, so a VC can greet one character with hostility, and another in a friendly way.

5.2.4 Performance Management

VCs, acting as virtual humans, need to perform multiple actions at the same time. Depending on what those actions, are and what parts of the body they require, actions can sometimes be performed in parallel. However, if actions conflict over resources, they must be performed in sequence over time, in some order that depends upon their importance. Actions may also be abandoned if they are delayed to the point that they are no longer important/relevant anymore.

The Social Simulator contains a component, called the performance manager that mediates among action requests. It implements the following task:

Given:

- A set of unfulfilled {performance, resource requirement} tuples.
- A subset of those performances executing at the current time.
- A decision opportunity, defined as the arrival of a new request, or the completion/termination of an existing request.

Choose:

- A set of requests to execute, and a set of requests to suspend.

The algorithm imposes a strict, priority ordered resource allocation scheme. We discuss the algorithm, and two methods for assigning priorities to performance requests, below.

5.2.4.1 Priority based resource allocation

A performance needs some subset of the body's resources, to express its performance. We have divided the body up into the following resources:

- LegsAndSpine (aka BaseFullBody)
- ArmLeftLayer
- ArmRightLayer
- HeadTrackingLayer
- SpeechLayer
- HeadLayer
- FacialExpressionLayer
- BodyPosture
- FeetPosAndBodyHeldWeight

The more "efficient" a performance can be, i.e. the fewer body resources it requires to express its meaning or accomplish its task, the more likely it is that other performances will be able to mix in with it and enact simultaneously (due to the absence of resource conflicts). Our algorithm distinguishes two types of resources: necessary, and optional. Behavior authors annotate every performance with the body resources it truly requires, and the resources that would be nice to have (aka optional). In more detail, each performance is annotated by required resources, optional resources, a timeout of how long to wait for resources before giving up, and whether to retry if interrupted. For example a brief performance to acknowledge that a player has spoken to a VC (i.e., turning to look and saying "hmm?") receives the following annotations:

```
performanceWME.requires(baseFullBody);
performanceWME.requires(headTracking);
performanceWME.requires(speech);
performanceWME.setTimeout(3000);
performanceWME.setBRetry(true);
```

Given data of this form, the resource allocation algorithm proceeds via the following steps:

1. Sort all new/active performances by their performance priority, putting the highest priority ones first, and among priority ties, putting the oldest performances first. Delete suspended performances that have timed out.
2. Iterate down the list of priority-sorted new/active performances. If all of the required resources for a given performance are available (i.e., none of them have been claimed), then claim all of those resources for that performance. (That performance is now considered "performable".) Otherwise, claim none. Continue iterating down the list of priority-sorted new/active performances; at least one performance (the first on the list) will have received all of its required resources.
3. Iterate again down the list of priority-sorted new/active performances, considering only the performances that either a) got all of their requested required resources, or b) had no required resources, only optional ones. If any of the optional resources for a given

performance are available, allocate them to that performance. This iteration may terminate without claiming any optional resources.

4. If a performance has lost its required resources, and was marked to not retry if interrupted, delete that performance.

In summary, each performance receives all of its required resources or none, and if successful, it additionally receives some to all of its optional resources. The (possibly multiple) winners of this competition are allowed to execute animations on the virtual body, and all other performances are suspended (if they were running), or queued until their requested resources become available. This algorithm runs whenever a new performance request arrives, or an existing performance ends.

On completion it is possible that:

- A new performance will not have received its required resources, and will be queued until such time as they appear.
- An existing performance will have lost its required resources to a new, higher priority performance with overlapping requirements, and will therefore be suspended, or deleted if marked not to retry.
- A new or existing performance will start or restart its performance.
- Many performances will receive resources, and subsequently execute in parallel.

5.2.4.2 Fixed Prioritization

The current suite of IMMERSE demonstration systems all employ a fixed prioritization model. In it, behavior authors assign a static priority to each performance for use by the resource allocation algorithm. We have grouped these priority annotations into tiers:

- **Very high priority performances**
  - scaredThreatened
  - rifle use
- **High priority performances**
  - briefAttention (noticing a new request from the player)
  - responding to a request from the player
  - requesting something emotionally charged, e.g. request putObjectDown
  - ventEmotion, throwObject
- **Medium priority performances**
  - objectTransaction
  - introduceByName
  - greet
  - thank
  - eatObject
- **Low priority performances**
  - briefChat
  - groupFormation
  - mirror

- whatsUp

- **Minimum (background) priority performances**
  - CarryMgr (right arm)
  - EmotiveStance idling (all but right arm)

While these assignments reflect a mixture of general and scenario specific concerns about desired flow, we have been able to employ this fixed priority model to produce performances that read well in all of the interactive experiences we have demonstrated to date. That said, the categorization is clearly a bit ad hoc, and it is unclear if the use of fixed priority tiers can scale. Our second approach to assigning performance priorities addresses these issues.

5.2.4.3 Linear Prioritization

Our second and more general approach to prioritizing performance requests takes a decision theoretic view. It defines priority in terms of a multi-attribute utility function that combines features of interest. We employ a linear function of the form

$$v = W \cdot F$$

where W is a vector of weights in the range (0 , 1), and F is a vector of features, also normalized to the (0, 1) range.

Before examining the structure of F, it is important to clarify the purpose of the value function v(W,F); it exists as input to the performance manager for use in interleaving performance requests. As a result, v(W,F) must generate smooth/readable performances and select against unnatural/jarring performances. The importance of a given performance to the character is only one element of the mix.

We have engineered two classes of features into the vector F; extrinsic features capture the purposes a performance serves, while intrinsic features capture properties of an individual performance that are material to smooth/readable flow. The extrinsic and intrinsic features include:

- **Extrinsic features:**
  - Utility of the action's results to the character.
  - Dramatic value of the action for the user's experience.
  - Importance of the action to the scenario.
  - Other application value of the action (e.g., its pedagogical value if in a tutoring system).
- **Intrinsic features:**
  - Continuity of the performance (relevance to previous action, e.g., if it is a part of a multi-step sequence).
  - Urgency of the performance (time window available for initiating action if it is to read well to observer).
  - Duration of the performance (time required to execute the action; a surrogate is whether the action requires locomotion).
  - Autonomic quality of the performance (the degree to which an action is involuntary, e.g., an emotional display).

- Inertia of the performance (extent to which the action, once initiated, should not be interrupted to read well - walking is an example, as it feels unnatural for a character to stop and start a walking motion multiple times).

We have implemented this linear prioritization model and demonstrated its use in a stand-alone excerpt of the Finding Farah scenario. Here, the two VCs each have an agenda, while the player interjects a request at a critical time:

- Yunos attempts to give fruit to the player. This launches GiveGift:ObjectTransaction(Yunos, Player, Fruit), causing Yunos to take fruit from Basuki and offer it to the player. Yunos executes this strategy until he takes offense because the player's response never arrives (a timeout condition).
- Basuki senses his fruit is stolen. This launches his SIU expressing irritation towards Yunos: RequestStepBack(Yunos, fruit).
- 1 second after Basuki begins RequestStepBack, the player shows the VCs a photo, implicitly asking them to identify the person involved. This initiates performances for both VCs to respond to the Request-Answer Social Signal.

We have conducted several experiments in this setting to assess the impact of feature weights on perceived performance quality (smoothness/readability). In particular, we annotated the underlying performance behaviors with sensible, fixed intrinsic feature values (using the ABL description primitive), and annotated each performance request with a reasonable, fixed, aggregate value for extrinsic features. Table 8 illustrates the annotations involved (null maps to 0, short, medium, and long/high map to 0, .5, and 1 respectively). Note that the value of continuity is determined from context; it is set to high if the SIU calling this performance was itself called by another SIU.

Table 8: Annotations Defining Intrinsic Properties of Performance Behaviors

	Urgency	Duration	Autonomic	Inertia
acquireObject_approach	null	long	null	medium
acquireObject_pickUp	null	short	null	medium
requester RequestStepBack	medium	short	medium	high
requesteeRequestStepBack	medium	short	null	null
offerObject_giver	null	long	null	medium
rejectOfferedObject_giver	medium	short	medium	high
showObject_showee_initialGlance	medium	long	null	medium
notComplyWithRequest_requesterRequestStepBack	medium	short	medium	high
notComplyWithRequest_requesteeRequestStepBack	medium	short	null	high
showObject_showee	medium	medium	null	low

The experiments demonstrate the following effects:

- No fixed, priority-independent execution policy generates high quality perceived performances. This includes variants on FIFO, and LIFO strategies.
- A selected weight vector W can generate high quality performances, equivalent to the use of hand-authored priority tiers. Anecdotally, that weight vector W was easy to find. This is the base case.
- The extrinsic features (taken in the aggregate) are material to perceived performance quality. As $W_{extrinsic}$ varies from 0 to 1 (with all other weights fixed from the base case)

performance quality alters significantly.

- Each intrinsic feature is material, on its own, to perceived performance quality (via the same procedure, as above).

In more detail, the FIFO policy creates non-responsive characters; Yunos executes his agenda to offer fruit to the player and ignores Basuki's irritation until that sequence completes. Similarly, Yunos fails to react to the player's photo show, since too much time has passed before he's free to perform the reaction. In contrast, the LIFO policy creates highly distractible characters; Basuki's complaint and Yunos's corresponding reaction are interrupted mid-sentence to respond to the photo.

If the weight on extrinsic features is elevated relative to the base case, the characters treat the player as overly important. This causes Basuki and Yunos to interrupt their argument midstream to look at the photograph, which appears unnatural. Elevated continuity weight favors the completion of full performance sequences, and approximates the LIFO policy. As a result, Yunos performs the full fruit offering sequence, ignoring both Basuki's complaint and the photo show. He belatedly responds to Basuki's complaint after the offer is rejected. Elevated urgency weight favors reactionary performances. As a result, both VCs promptly react to the player's photo show, which delays the non-urgent fruit theft and resultant complaint sequence. The loss in perceived performance quality is relatively small, although the issue is once again that characters have difficulty pursuing longer term agendas. Elevated inertia weight favors performance completion without interruption. Basuki performs his full photo glance before reacting to the fruit theft, which is clearly unreasonable.

Depressed duration weight removes the priority advantage given to short (non-locomoting) performances. In the base case, after his initial approach, Yunos chooses to pick up the fruit instead of looking at the photograph in part because the fruit pickup is short (stationary) while the photo investigation is long (it involves a walk to the player). With duration weight set low, Yunos chooses to examine the photo first instead, and walks to the player. After the examination, he resumes the theft sequence, which requires returning to Yunos. This results in extra locomotion, and a slight decrease in perceived performance quality.

A depressed autonomic feature weight causes characters to be jarringly non-responsive. To illustrate this case, we added an action to the experimental scenario where the player rushes at the VCs, and the VC's startle reaction has a high autonomic feature value. In this situation, the VCs did not respond to the player's rapid advance until the 3rd attempt.

Our work on IMMERSE has introduced an approach to unscripted interaction with virtual characters that relies on satisfying dynamically generating performance requests. This framework is novel with respect to the gaming industry, and most virtual character research. Our use of a value function to generate aesthetically pleasing performance sequences is similarly novel. Our preliminary experiments have shown that a linear model composed of extrinsic and intrinsic features has the expressive power to generate nuanced performances, and that the specific feature set is salient, and material to the perceived quality of the resulting behavior. However, we have not demonstrated completeness or independence of the feature set, and while this approach has the potential to scale up, we have not tested that conjecture. Future work should examine whether behavior authors find it easy, or hard to control the degrees of freedom present within the linear model.

An alternate perspective is that the extrinsic and intrinsic feature sets represent a natural vocabulary for describing performances, and that the feature values are determined by performance content and purpose. In this view, authors delegate aesthetic choices to the performance manager by defining a tradeoff function via a vector of weights. If the feature set is adequate, and the weights reflect author preferences, the resulting behavior is by definition good. In our experience, authors need the ability to override system decisions in specialized contexts, but the approach of delegating the vast majority of such decisions could easily scale.

5.2.5 Attention Management

In order to create lifelike interactive characters for the purpose of teaching effective social engagement, it is important to for the player to be able to assess the motivations of the characters they are interacting with, from their gestures, body language and facial expressions. How a character distributes its attention between a multitude of possible subjects, including other characters and the player is often overlooked in avatar systems, where characters, quite unnaturally, shift their attention entirely from one character or object to another.

In reality, human beings distribute their attention (and alter the distribution of their attention) based on a number of factors, including mood, status/social position, and relationship with the subjects of attention. In addition, an instantaneous shift in attention can be externally motivated by a sudden noise or the unexpected appearance of an object in the characters field of view, or internally motivated, as when a character is completing one task and moving on to another. These motivations call for differing attention-shift scenarios. A character (or person) tends to communicate an internally motivated shift by re-orienting their body before their head and eyes. Externally motivated attention shifts follow the opposite order; eyes, head and body move toward a new object of attention in that sequence. The speed, or urgency, with which these redirections occur follows the importance of the stimuli. The quantity of resource called into play responds in a similar way. For example, a fly at the edge of your vision might command a quick flick of the eyes. A conversation in the next room might draw your eyes, then head, and torso in gradual succession. In contrast, your decision to walk to the refrigerator might become visible first in your feet and hips, and shortly thereafter in your head and eyes.

We have implemented a rudimentary attention management capability in the existing system, and have developed several stand-alone prototypes in Unity to illustrate the basic behavior. The most recent accepts the urgency, intensity, location, and internal/external motivation of a stimuli as input, and then executes an attention shift while recruiting an appropriate amount of body resources into the action as a function of time.

6. Social Pedagogy

In IMMERSE, social skills are fostered through guided practice within a socially rich virtual environment that presents authentic and varied social encounters. A social coaching component supplements the experiences available in the social simulation to produce more effective training as well as more efficient training, an important consideration for the eventual integration of social competency training into military and law enforcement training regimens.

6.1 Designing Social Encounters

The learning experience is not the province of any single system component, but arises from the interactions of game play; the social simulation's ability to generate believable and engaging characters, behaviors and situations; and the pedagogical component's ability to deliver timely, apt instructional guidance. IMMERSE creates social contexts that go well beyond any structured scenario approach to experience design. VCs are simultaneously engaged in multiple behaviors, possess different social traits and motivations and are able to initiate interactions with the learner.

Writing robust behaviors characteristic of specific social settings (e.g., approaching strangers to enlist their aid in locating a missing person) has the beneficial side effect of creating natural forms of scaffolding for social interaction. This derives from the common ground inherent in all social encounters that presupposes both parties are genuinely involved and trying to communicate their intent. This can lead naturally to supportive behaviors being introduced, which invite the learner to participate; e.g., asking to see a picture of the missing person. These behaviors become pedagogical affordances made available to a coaching component, and play the role of guiding the learner to desired courses of action. Another characteristic of social encounters – prevalent in cross-cultural settings – is the unavoidable confusion or trouble that can arise within a discourse. Recognizing trouble and collectively seeking remedy is integral to social competence.

6.2 The Social Simulation as a Training Vehicle

The primary pedagogical impact of IMMERSE is inherent in the authored experiences presented to learners. The social simulation is not a neutral practice environment where anything can happen at any time. The setting, VC motivations and resulting behaviors, and considered reactions to learner behaviors combine (in sometimes unpredictable ways) to steer the experience toward one of several designed pedagogical outcomes. IMMERSE emphasizes the following elements in the design of pedagogical experiences:

Framing. It is important to "set up the problem" when introducing a learner to an experience. Learners have a strong desire to be given specific goals to accomplish (a mission). Military personnel in particular expect a level of Doctrinal validity, consistent with known tactics, techniques and procedures. The vagueness of the Sandbox scenario was a stumbling block for many learners, although it could be argued that "just getting to know the local populace" is a worthy goal in many situations.

Training for future conflicts. Scenarios were purposely set in unidentifiable countries with unrecognizable languages and unfamiliar social norms. The intention was to force learners to adapt and not fall back on habits and expectations formed during prior deployments. Experiences were designed to require social competency to succeed.

Realism (just enough). Behaviors include performance actions and modes that make affordances and consequences more clear and poignant than they might be in a natural setting. Avatar expressions and gestures were designed for readability over life-like-ness. There is a tension between a natural desire for high-fidelity appearances and performances (expressiveness) and pedagogical salience.

Modeling. VCs implicitly demonstrate efficacious (and counterproductive) behavior. Modeling behaviors for the learner draws attention to affordances and encourages mimicry – an important meta-cultural skill in its own right.

Immersion. Story, performance and VC engagement with the learner all serve to motivate the learner to continue the interaction and explore alternative actions and outcomes.

Critical junctures. Critical junctures are points and intervals in an unfolding social situation where the learner's diagnosis of the situation and course of action (or inaction) has a large impact of the outcome of the situation. Internally, these are expressed as desired social state and co-occurrence of SIUs. Though not the same as dramatic peaks, they are brought about by the human designers of the scenario and supported by the pedagogical elements of the system. For example, in Finding Farah, taking advantage of the proffered fruit to establish rapport before getting the point of the mission has a large impact on the outcome; i.e., whether the VCs decide to help you. Of course the learner may not even have realized he could or should do anything at all at that point: he may be unaware of the "social affordances" available in the situation. Social Affordances are social behaviors that will have specific effects at specific times. They can be thought of as options or opportunities that the situation makes available.

Consequences. The consequences of the learner's action, as manifested in the VC's behaviors, are the principal form of feedback in IMMERSE. The responsiveness of the social simulation delivers intrinsic rewards (and penalties) moment-by-moment. Game-like accoutrement to tally the player's successes and failures are deliberately not part of the IMMERSE interface. Rather successes and failures are made obvious to the learner (e.g., the head-of-household in Breaking Bread throwing the fruit bowl on the floor). Social competency hinges on learning to pay attention to reactions and adjusting one's behavior accordingly, so this is designed into the experiences.

Outcomes. Experiences are designed around a set of outcomes. In practice, the behaviors of the VCs - though not scripted in any literal sense - do tend to culminate in a small set of terminal interaction states. For example, in Finding Farah, one can alienate the VCs and obtain no information, exert force to obtain limited information, or gain their full cooperation. Possible outcomes are important design criteria; they become the main instructional "points" for the scenario.

Replay. Experiences are designed encourage repetition: to achieve different outcomes or to achieve a particular outcome more economically or with fewer adverse side-effects. This hallmark of game-play rewards experimentation and alleviates feelings of failure that a single poorly executed all-or-none training event can produce. Section 6.4 on After Action Review shows how to ensure replay is a productive activity.

6.3 The Social Coach

Instructional design in IMMERSE involves guiding the learner through situations where social skills determine the outcome and consequences are visible. The SSIM program posed this

question to a cadre of social scientists in this form: What makes a warfighter a “good stranger,” able to create positive social outcomes within the context of other mission objectives, even in the face of unfamiliar cultural contexts and conflicting social norms? One distillation of their findings emphasized these cross-cutting skills: interpreting non-verbal cues, perspective-taking, managing the encounter, building rapport, maintaining self-control, maintaining self-awareness and recognizing social affordances. Social encounters in IMMERSE are designed to foster these skills; e.g., observing and adopting situationally appropriate rituals like greeting.

IMMERSE is a guided practice environment. The forms of guidance derive from the tenets of Cognitive Apprenticeship (Collins et al., 1989; Collins, 1991), which offers a compelling argument for modeling learning on traditional forms of apprenticeship – coaching and modeling behaviors to guide the learner experience in the virtual environment, providing feedback, scaffolding and fading, and a graduated exposure to increasingly difficult, complex and varied situations. However, the dynamic and dramatic qualities of the social simulation have forced us to extend traditional notions of guidance and feedback usually associated with coaching. Since we theorize that immersion in a social discourse is a prerequisite for learning, so the coach must respect the dramatic flow of the interaction by not undermining learner engagement. To avoid being a distraction, the social coach must itself respect conversational conventions; e.g., through implicit turn taking with the learner and other interlocutors. The earlier discussion of junctures also affects the role of feedback, and because learning social competency involves behavior change, exposure to extreme situations and failure may be an essential ingredient in the feedback process.

Coaching includes speaking to the learner as well as altering the visual scene by zooming the camera to focus attention on a particular VC behavior, or other forms of highlighting elements in the scene. These forms of explicit coaching are augmented by the implicit coaching inherent in the behaviors of the VCs. The rich social simulation and expressive performance capabilities makes possible natural forms of guidance and feedback. VC facial expressions, gestures and other embodied behavior can vividly reveal short and longer-term consequences to learner actions (or inaction). Moreover, VCs can model, actively solicit or suggest actions for the learner.

Despite concerns about in-game coaching interfering with immersion, there are situations that warrant such interventions. For example, when a learner reaches an impasse, the coach can suggest a course of action to keep the encounter moving forward. We have the ability to pause the entire simulation, which can be used to create a “tactical pause” to reorient and scaffold a struggling learner. Some scenarios have more distinct scenes; e.g., going from group to group in a village square to locate a missing person in Lost Interpreter. These scenarios create natural gaps in the story that allow the coach to jump in with suggestions or praise.

Another kind of impasse presents itself as a hesitancy to engage with the system at all. Despite the framing provided at the start of a session – treat the VCs as if they were real people, remember that they can see and hear you – some noticeable fraction of users fail to participate; they just stand there waiting for something to happen as if they are watching a movie play out in front of them. Since they are not engaged, there is nothing to lose by interjecting a reminder that one should not treat the experience as a movie to be watched, but an experience to be inhabited.

6.4 After Action Review

Notwithstanding this ability to deliver coaching during an experience, over the course of the project increasing emphasis has been placed on a brief summative after action review over in-game coaching. For one thing, the experiences are short – 2-3 minutes – and easily disrupted by taking the player's attention away from the action. For another, increasing effort was spent on the quality of the VC's performance – its expressiveness and readability – which constitutes the principal form of feedback and guidance for the player. Finally, the structure of the experiences – the points they are trying to make – manifest in their outcomes (did the VCs get angry at you, at one another, did they try to help you or were they suspicious of you, …)

After each run-through of a scenario, the player is presented with a short summary. The template for this AAR is simple: first, characterize the outcome and how the player's actions might have contributed to it; offer one or two suggestions for things to try the next time. The intent is to take full advantage of the replay opportunities inherent in IMMERSE, and to suggest to the player a small number of alternative behaviors that might produce more desirable outcomes the next time through (greet others, introduce yourself, accept offers, ask yourself who was more friendly and accommodating).

6.5 Role of the Pedagogic Director (PD)

The form of integration between the social simulation engine (and the social coach) and the PD was driven by the decision to keep the two software components separate. This begs the question of how much (and what) information should be passed to the PD about the inner workings of the SS, and led to the framework whereby the SS proposes and the PD disposes. All pedagogically relevant options are generated in the SS, either as VC behaviors or explicit coaching interventions. The PD sorts and filters these options and passes its choice back to the SS for execution. A shortcoming of this approach is that the PD lacks full insight into the reasoning of the SS, which limits its ability to plan a trajectory of experience for the learner. In reality, by the time social moves were proposed, the SS had made major decisions about the possible direction of the interaction, leaving few meaningful choices for the PD.

The PD comes into its own in monitoring a learner's accomplishments over time. During the course of the project, SSIM created a series of experiences to drive the underlying technology, the research agenda, and explore a variety of types of experiences. SSIM never aspired to create anything close to what would be called a curriculum. Because of this, it was not able to benefit from the PD's capabilities in this area. Additional future work on SS-PD integration should explore the pedagogical policy options that guide the PD's decision-making; e.g., weighing variability for its own sake against narrative flow and believability, or the utility of exposing the learner into a complex situation early on – when failure is likely – in the interests of shaking the learner loose from feelings of overconfidence.

7. Additional Knowledge Products

7.1 Gap Analysis and Social Science

As part of BBN's IMMERSE effort, MacroCognition assisted in transferring results from the SSIM TA1 effort into products useful for social simulation. During Phase 1 of the effort, MacroCognition defined 13 KSAs (Knowledge, Skills and Abilities/Attitudes) which were key to social interactions skills and "Good Stranger" behavior. See Appendix 13.4 for additional details. In Phases 2 and 3 of SSIM, MacroCognition conducted a Gap Analysis, seeking to identify the cognitive, behavioral and perceptual gaps between the Good Stranger (GS) skills needed and those possessed by the military personnel. As part of that effort, they collected data from 138 Non Commissioned Officers (NCOs) at Ft. Benning. Findings from the Gap Analysis are included in Appendix 13.4 and include theoretical as well as practical implications for military training.

7.2 Model of Social Balance (imposition/redress)

SIFT (Smart Information Flow Technologies) conducted research to determine how to best represent non- or extra-verbal "body behaviors (e.g., posture, movement, gesture, facial expressions, verbal prosody, tone and volume, etc.) within the framework of the Etiquette Engine, previously developed as an adjunct to DARPA's DARWARS projects. The Etiquette Engine is a computational instantiation and elaboration of Brown and Levinson's [1] theoretical model of politeness and its role in shaping and managing interpersonal relationships. It was based primarily on verbal expressions in discourse and relied primarily on word usage in utterances to trigger and compute effects in the turn taking typical of dialogue. The goal of this work was to explore how the Etiquette Engine might be expanded, both in terms of its underlying theory and in terms of its computational representation, to incorporate non- and extraverbal behaviors, as focused on in the SSIM project. The project final report can be found in Appendix 13.3.

8. Lessons Learned

8.1 Learner Viewport Window Into Another World

When a player is engaged in an SSIM interaction, they're standing, gesturing, and moving around, just as they would in an interaction with a real person. This means that they are viewing the screen at a frequently shifting angle. If the characters maintain eye contact with the "camera" and do not track the player's movement, then the simulation can feel flat, static, and unresponsive, to both players and observers.

However, if the characters simply turn their heads or eyes to follow the player's movement, the resulting experience doesn't feel correct. Because of the Mona Lisa effect, a character's gaze is perceived as relative to the observer – that is, if characters are looking straight at the camera, viewers in any position will perceive them as making eye contact, whereas if they are looking slightly to the left of the camera, viewers in any position will perceive the characters as looking slightly to their left. Thus, the experience becomes disorienting for the player, and though observers will notice a greater degree of responsiveness to the player's actions, if they pay close attention they will also feel as though the characters are not looking in the correct place.

The solution we used, referred to as "VR mode", was to place the virtual camera at a point in the simulation corresponding to the position of the player's head, so that what is displayed on screen is what the player would be seeing if they were standing inside the simulation, looking through a window (the screen). If the player moves to the left, they will be able to see further to the right, and vice versa. A character on screen can track the camera with their head, and they will be both visibly moving to keep the player in view as they move, and still maintaining eye contact. Overall, this greatly improves the subjective sense of the simulation as a "real", three-dimensional place.

The effects of VR mode, however, are specifically tailored to the player. Observers can see that the system is responding to the player's movement, but they do not experience the same subjective impressions. Ultimately, we decided that the player's experience was the most important factor, and that it was not worth compromising in exchange for what were relatively minor gains for observers.

Figures 17a, 17b, and 17c each represent one approach to the problem of VC gaze, and each column represents a different view of the screen. In 17a, the VC keeps their gaze fixed on the camera, and so does not move while the player walks around, but appears to be maintaining eye contact. In 17b, the VC tries to watch the player, but it will always look at though they are looking in the wrong direction. Finally, 17c represents "VR mode", the solution we used, in which the player's view of the simulation moves when the player does, as though they were looking through a window. Note that, in the first two figures, even when looking at the screen from the side, the VC is seen "head on" and the background does not change, whereas in the final row, looking at the VC from the side provides an appropriately angled view.

Figure 17a. Character watches camera

Figure 17b. Character watches player

Figure 17c. "VR Mode"

8.2 Encoding Social Interaction Requires a Human Model

At the mechanical level, this meant that we acted out (role-played) multiple variants of our demonstration scenarios on camera, so that we could dissect our own performances for social content (as well as animation models). The rationale is that social behavior is so ingrained (analogous to physical skills) that our purposes, strategies, social communications and physical signals are not easily available for introspection. We found that we designed SIUs and social games by looking at what we did, vs. what we planned.

8.3 Expressive AI System Development is a Deeply Incremental Process

We found that we needed to build behavior, see it on the screen, and refine it to a level of expressive quality that let us perceive the next layer of issues we needed to address without being distracted by performance artifacts. This process repeatedly delayed work on general mechanism in favor of character performance. Some version of this tension is always present in large system development activities, but it has a novel flavor here. Research on expressive interaction requires an iterative, incremental methodology to be feasible at all.

8.4 Long Duration Pre-planned Behavior Sequences Inhibit Interaction

The goal of supporting non-scripted social interactions between the player and virtual characters exerted a strong influence on our technical work. This effect became apparent when we

attempted to employ such durative strategies in our early demonstrations. In addition, we found that characters become unresponsive if the player did not respond with any of the inputs anticipated by the character's agenda. This is a separate, but related issue. We considered the use of strongly reactive coding techniques that would allow SIUs to be arbitrarily suspended and resumed under changed environmental conditions, but concluded that the desire for unscripted social interaction selected for a more compositional model. We learned that our approach of assembling interactions from primitive social elements (motivations, moves, and SIUs) enabled emergent social behavior.

8.5 Whole-body Interaction Entails a Profoundly Difficult Sensor Processing Task

Despite a good deal of attention to signal filtering, we had to place strong expectations on player input to address issues with false positives and negatives in gesture recognition. This narrowed the breadth of allowed player input, frequently in uncomfortable ways. Given more time and resources, and especially in hindsight, we would have engaged this issue directly by employing stronger filtering methods as well as active uncertainty resolution techniques. For example, we arguably should have employed expectations to condition perception via hidden Markov models, and could have resolved social ambiguities through non-verbal dialogue interactions between the player and characters.

9. Unanswered Questions about Social Interaction with Virtual Characters

9.1 Player Locomotion

The problem of player locomotion is persistent, and imposes serious limitations on the design of virtual interactions. Our system has used several different control schemes, each with its own benefits and drawbacks.

Currently, players can move about physically in order to control their location in the simulation. This mode of movement is very natural and unobtrusive, but it means that the player can only meaningfully move within the space both visible to the sensors and in view of the screen. Therefore, scenarios using this method must account for the fact that the player will have to remain in roughly the same overall position, and will view the scene from a fairly restricted set of angles – the player cannot look behind themselves, or interpose themselves between two characters, for example.

Earlier on, in the Lost Interpreter scenario, players could move about locally just as they can now, but could also move their character using a hand-held controller with an analogue stick. This provided a much greater range of motion, as a player could turn around, walk up to specific groups of people, and otherwise navigate the virtual space using the controller, while still being able to make finer adjustments with natural, physical movements. The chief drawback to this method, apart from the higher learning barrier, is that it is very unnatural. The dissonance involved in controlling your character in a “game-like” way with a controller, while also attempting to engage in social interactions in which you must pretend you are not holding that same controller, is very damaging to the sense of immersion. Using two different methods to move about can feel awkward and arbitrary, and is overall distracting.

Another solution considered but not used in this project, would be to use scripted transitions between parts of a scene. For example, when you finish talking to someone, you might automatically walk over to another group of people. This falls into the category of methods that might serve in practical terms to remove the controller while still allowing motion, but cannot be considered a full solution. The player still has only a limited range of motion under their control, and there is still an unusual, disorienting disconnect between the two locomotion methods.

VR headsets solve the problem of a stationary screen, and allow the player to turn around in a natural fashion, but they make the problem of locomotion even more pronounced. It is more disorienting if the character’s movement does not correspond to movement of the player (as when using a controller or scripted transitions), and a freely-wandering player might have a slightly larger range of motion (because they no longer have to keep the screen in view) but they must contend with the more pressing problem of, essentially, walking around blindfolded.

There have been several attempts to create easy-to-use omnidirectional treadmills that would allow a player to walk in any direction in a natural way and so navigate in a simulation (perceived via a VR headset), without physically moving around. For example, the player might stand inside a large, hollow sphere, allowed to roll freely in place. Unfortunately, these tend to be expensive, bulky, and difficult to use.

9.2 Interacting with Real and Virtual Objects

Interacting directly with objects in a virtual space presents unique challenges. The mismatch between what the player is seeing, what they are able to touch and feel, and what they are intended to believe is going on in the scenario, can be difficult to reconcile satisfactorily. If the player must interact with virtual objects without a physical correlate, they can be difficult to manipulate. Can you put your ID in your pocket? Move it from one hand to the other? Even the most basic information – are you holding something, and if so, what – can be difficult to convey and easy to forget.

Using a physical object to match a virtual one, though, is an even trickier territory. Such an object could interfere with sensors intended to track the player, and would require additional sensing to determine whether the player has swapped hands, put it away, or is holding it at an awkward angle. Those difficulties, though, are relatively tractable, and could be worked out for interactions involving very specific items that the player will keep on them at all times. But what if you're intended to give the object to someone, take it from them, or put it on a (virtual) table? What if you might want to take (and eat) multiple pieces of fruit? This technique can quickly get out of hand.

The technique we used to address this issue is a visual "inventory" displayed on the screen. If a player picks up an object, it is displayed on screen in the appropriate hand (as a somewhat abstracted image). If the player extends a hand with an object forward, the inventory image gets larger. Though these objects can't be put away or swapped between hands, there's a constant reminder of what the players are holding. Additionally, during development of the Breaking Bread scenario, we tested the use of a rifle-shaped controller. This scenario managed to avoid many of the above problems with physical representations of virtual objects, because it couldn't leave the player's possession, and there was a very limited range of sensible actions that could be performed with it (the scenario ended if the rifle was aimed at a person). All of these techniques had significant tradeoffs to consider, and it is yet to be determined what solution is best overall.

9.3 Animation Combinations and Stage Management

The animation requirements of a system like this are complex. Whereas normally a game or simulation would be able to use finite state machines to control the transitions between specific animations, and use perhaps one or two additional layers of animations or inverse kinematic aiming, in this project we use more than ten distinct conceptual layers and we permit any animation to transition directly into any other. A character might be walking towards a table to pick something up when they notice a friend of theirs , they continue to walk, look at the other character, smile, nod, wave, and pick up the object. More than that, this sort of mixing of animations must occur on the fly, in reaction to unpredictable actions from the player, on varying time scales down to the fraction of a second (for instance, flinching if the player yells).

Characters must also have some form of awareness of their positioning relative to other characters, and establish proper positioning without distracting from social interactions. For instance, they should make sure not to block anyone's line of sight, move around others without bumping into them, and stay at a socially appropriate distance from those they're interacting with (whatever that happens to be at the time). These concerns can seem small, but players will feel instinctively that the interaction is 'wrong' if characters don't abide by them.

Another layer of complication is added by the fact that characters must fulfill these obligations with a limited array of resources, both physical (two hands, two eyes that must generally focus on the same thing, etc.) and mental (attention, cognition, perception, etc.). Tasks of varying importance and urgency can arise at a moment's notice, and the correct reaction can depend heavily on context. You might put down your cup of coffee to shake hands with the President, but if you see a priceless vase falling, you don't have time to look for a coaster.

In future projects, more advanced animation systems could help make these interactions seem more natural, or, alternately, more stylized and abstract characters could be easier to animate. Procedural animation is likely to play a part, given the broadness and context-sensitivity of the challenge. We've made a concerted effort, via systems of resources, adjustable performance priority, and layers of animations, to allow our characters to fulfill all of the performance requirements imposed upon them, but there is still a great deal of work required in this area.

10. Recommendations on the Way Ahead

The following section describes several key areas of research and development necessary to expand the state-of-the-art in social simulation.

10.1 Authoring for Social Simulation

Our work on the DARPA SSIM program has taught us that writing scenarios for social interaction simulators is hard work and currently requires skilled programmers who understand social interaction, automated pedagogy, and DoD mission requirements. Yet, the runaway success of Ambush! taught us that game-based training will only receive wide adoption if training (and learning) communities can easily create their own content. Therefore, new, AI-supported authoring tools are needed so that non-programmer, DoD stakeholders can independently develop the complex social scenarios needed for Human Dimension training and mission rehearsal.

Such authoring tools will need to meet several broad requirements. They must: 1) be trainable, usable and satisfying for learners, trainers and SMEs to use, rather than requiring software developers; 2) support a simulation-asset writing and sharing ecosystem; 3) implicitly support a pedagogical orientation, without forcing simplification of the experiences, challenges and outcomes that are produced; 4) support a story-to-game pipeline for rapid translation of operational incidents into training experiences; and 5) support testing and revision.

The IMMERSE project developed a model of social simulation that supports spontaneous unscripted interactions with groups of virtual characters. A primary element of this approach is the concept of Social Games, described above. While IMMERSE has focused on creating this novel capability, feasibility for widespread use is a next, obvious concern; in place of relying on programmers to write rules and procedures for generating character behavior, authors should be able to produce social pedagogy with synthetic characters via GUI based authoring in vastly less time.

We think that such a capability can be created and deployed over the course of three to five years with service personnel involvement beginning during the first year and accelerating to full ownership of the capability at the endeavor's end.

10.1.1 Prototype Experience Envelope Visualization

Toward the end of the SSIM program, we considered how scenario authoring might work in the future, and wondered whether we might visualize, and some day perhaps adjust (via the visualization), the full state-space of everything that could ever happen in a given scenario. Figure 18 shows a rapidly developed prototype (really more of a conversation piece) illustrating what this might look like, based on the Finding Farah scenario. Each red, gray, and green box represents a player move in the scenario, while the outcome of the move is represented by its color (green for success, red for VC rejection, gray for no significant state change). Each column of boxes represents enough time passing in the scenario for the player to perform an action, while each row of boxes represents one possible path through the scenario (a unique sequence of actions by the player). The "String Length" slider allows for the visualization of more or fewer player moves, while the "FruitAlliance" slider provides an example of changing a parameter in the scenario to see instantly what effect the change has on the entire state space. The blue text and the two graphs on the right show information about the row of boxes currently under the cursor: the text shows what player actions the boxes represent, and the charts show

how certain social state elements change over time in that scenario given that unique sequence of player actions. Finally, the Player Type menu allows for the selection of specific "quintessential" sequences of player actions (e.g. "Impatient Authority-Wielding", "Patient Friendly") or "U*" to allow for exploration of the entire state space, as we see in Figure 18.

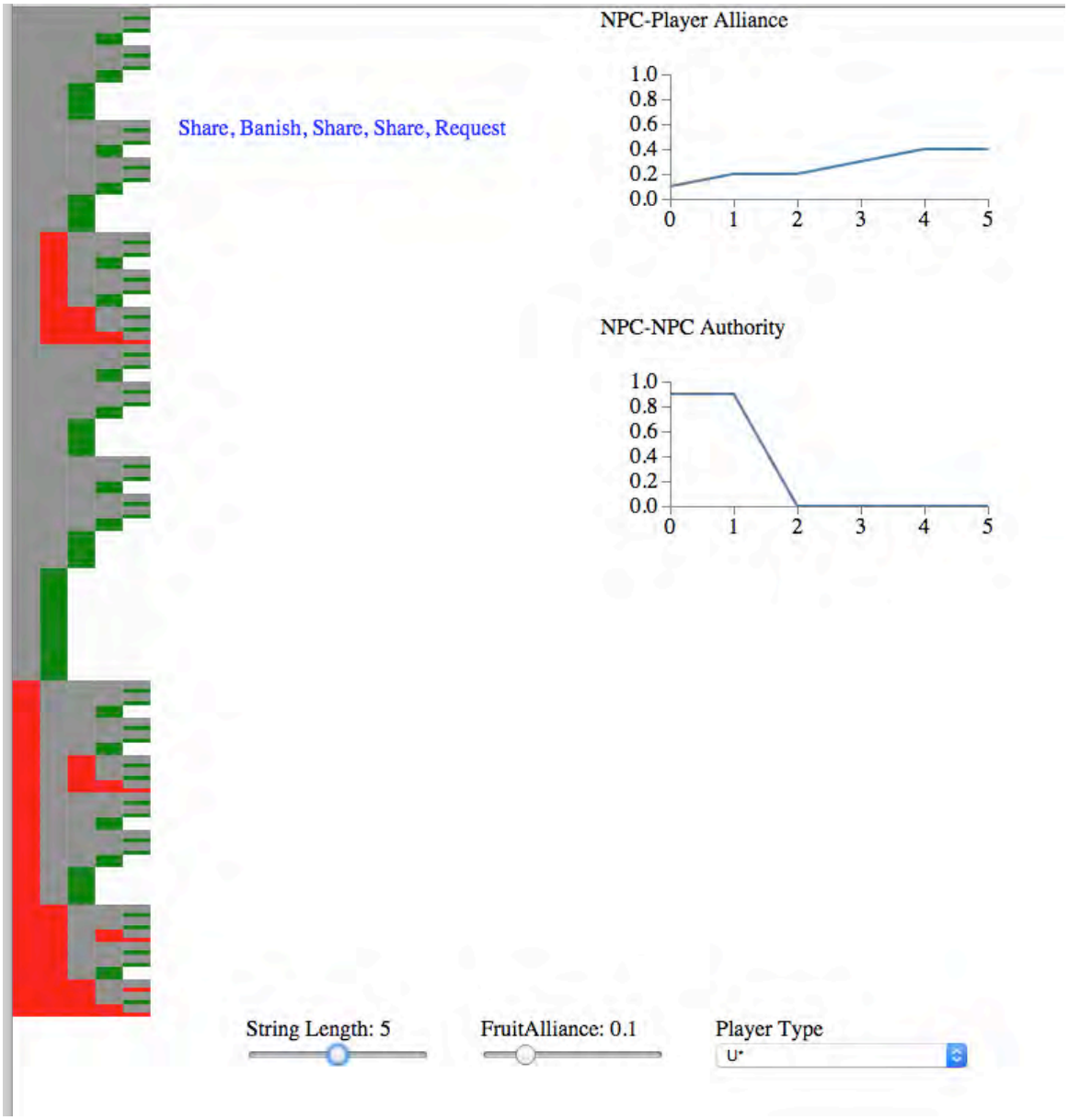

Figure 18: Scenario State Space Visualization Prototype

Turning this conversation piece into something useful is left as an exercise for future development. Obvious issues include dealing with simplifying assumptions here about time quantization and the number of relevant player actions, e.g., as well as addressing the fact that social state is naturally far more complex in real scenarios. Furthermore, the authoring of the AI rules that govern behavior in the existing system is entirely bottom-up: specific rules are authored by human developers that govern agent behavior, and those rules are refined until the behavior that emerges from the agents is what we hope to see. The possibility of using a state

space visualizer to adjust agent behavior suggests the presupposition of an entirely inverted approach to behavior authoring – one probably based either partially or entirely on machine learning.

10.2 Content Based Architectures for Social Simulation

With the rise of industry-leading game-engines, like the Unreal Engine and Unity, interactive 3D content-authoring has moved from the, almost exclusive, domain of computer programmers to one in which technical artists and game designers with little or no programming experience can create highly sophisticated games and interactive experiences. This has been possible by the shift toward content-based architectures, in which assets, and their behaviors and relationships, are created using visual authoring tools which are used to determine the code that will be executed at run-time.

At present, the Social Simulator is implemented as a set of API's and language features in ABL that support the creation of social rules, interactive behaviors, and physical performances by animated avatars. While this has facilitated the rapid prototyping of simple scenarios by software engineers proficient in the language, the lack of a formalized content model, independent of the language, greatly limits the ability to create more complex scenarios, or to create tools for pedagogic experts and other users who may not be skilled computer programmers.

The obvious next step is to apply the content-based architecture model that is so effective in the commercial, high-end video game production to the task of authoring social games and behaviors. This transformation would adapt the technology to preserve many of the control concepts found in the current ABL implementation. Our initial work in this area suggests that the marriage is quite feasible, and would greatly facilitate the creation of unscripted social interaction scenarios, which are quite novel relative to game industry applications.

10.3 Recombinable Content

While the content based model facilitates authoring by scaling up the instantiation of behavior patterns, the patterns themselves must be defined in a reusable and recombinable form. As discussed earlier, social behaviors have novel content and structure, and need some generalization to mate with the content-based model. Our work on IMMERSE has solved a major portion of this issue; social games, motivations, moves, and SIUs are already expressed in terms of simple elements that can be utilized in arbitrary orders and combinations. However, they have not been organized into assets whose internal structure can be instantiated and modified in stereotypical ways.

We can accomplish this transformation by refactoring the implementation of games, motivations, moves, SIUs, and the component behaviors into stereotypical patterns with fixed and variable (author-selected) elements. This involves inventing, and clarifying idioms as well as factoring content, for example, to separate the function and allowed content of nomination and preference rules, and to define models (idioms) for utilizing magic numbers to assign volition.

This task is quite feasible. We have examined the problem of porting a social game across scenarios in detail, including several subtasks:

- defining a new move, with new nomination and scoring logic
- defining a new SIU that must be mated to the intention formation chain,
- specializing an existing social move to operate in a new context (with modification of the

intention formation logic), and

- specializing an existing SIU to take appropriate action in a new context.

In all cases, the idioms utilized in our existing work mapped into the content based authoring format in straightforward ways.

10.4 New Kinds of Synthetic Experiences

One clear direction for future work is to build applications of our social interaction technology. In particular, while this contract has created proof of concept experiences for practicing social skills with virtual characters, UCSC and BBN have recently developed games for IARPA that cause perspective shift by provoking players to internalize another culture's mindset. We can combine these threads to produce a new genre of highly effective cross-cultural training games that will give warfighters deep insight into human dimension concerns.

In more detail, we learned several lessons from SSIM and the IARPA EMIC efforts that suggest a practical way forward. Our work on SSIM taught us that social competence can only be mastered through practice in the context of dynamic, joint endeavors. That practice can occur in simulation or between people. Second, our work on EMIC taught us that cross-cultural training can go far beyond instruction in social conventions (e.g., bowing, when to look or not look someone in the eye); it can teach deep perspective shift through visceral first person experiences. Third, the EMIC project identified game design principles that generate perspective shift. The key insight is to impose rules on the interaction that make culturally foreign perceptions, motivations, and action options visible to the player, and that similarly discourage non-native (e.g., American) perceptions, motivations, and responses. These principles are applicable to simulation-based games, as well as live role-play interactions.

We believe that we can apply these lessons to build a genre of training games that will give warfighters nuanced insight into the mindsets of organizations like ISIS, Hezbollah, Boko Haram, and others, who will populate the human terrain of likely future battle environments. For example, a game can communicate the centrality of Sharia law to the non-Islamic mind by causing players to enforce such laws within the game, while receiving approval from peers. Techniques of this form are already in use in "bleed LARPS"; live action role-play games designed to affect a player's thoughts and feelings in their daily lives.

This synthesis of ideas suggests two complementary ways forward. The low-tech path employs live role-playing games as opposed to simulators to deliver social training. This approach can be delivered at scale because the game's content and rules communicate the pedagogical material obtained from social scientists and other subject matter experts. As a result, warfighters can learn from playing the game, absent an instructor. The high-tech approach employs social simulation as in the SSIM project, using the EMIC model to design perspective shift training. The resulting experiences can be presented in the form of a web or tablet based game, and delivered at scale through replication.

11. Conclusion

We believe that the BBN team and its collaborators have substantially advanced the state of the art in embodied interactions with virtual, artificial intelligence controlled characters while moving toward enabling real social interaction in a synthetic setting. This work could be exploited to produce evaluatable training capability for teaching social competence. Our team members would be more than happy to continue in this direction.

As we have carried out our work for DARPA under SSIM, we have been aware of a parallel movement inside if the Army (though other services are also involved) towards defining a "Seventh Warfighting Requirement" which may be called "Engagement". Basically this is the capacity to execute missions that involve non-kinetic interactions with civilians and members of other fighting forces in contexts where influence and trust are critical to mission success and where there may be ubiquitous, embedded enemy elements. These are operations in the Human Domain. As this (much needed) doctrinal change evolves over time, we expect that the work done under the SSIM program can be used to meet the profound training requirements that will be derived from requirement.

In any case, we hope that the SSIM simulator that we have constructed and the insights gained from its production will enable new solutions to being ready for whatever tomorrow requires of our warfighters, police officers, emergency responders and anyone else whose work depends on interacting across cultural boundaries in high stakes social situations.

12. Acknowledgements

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13. Appendices

13.1 List of Symbols, Abbreviations, and Acronyms

AAR	After-Action Report
ABL	A Behavior Language
AI	Artificial Intelligence
API	Application Program Interface
AR	Augmented Reality
DARPA	Defense Advanced Research Projects Agency
DoD	Department of Defense
GS	Good Stranger
GUI	Graphical User Interface
HoH	Head of Household
IARPA	Intelligence Advanced Research Projects Activity
IK	Inverse Kinematics
IMMERSE	Interactive Mentoring for Multimodal Experiences in Realistic Social Encounters
ISIS	Islamic State of Iraq and Syria
KSA	Knowledge, Skills & Abilities/Attributes
LARP	Live-Action Role Play
LN/LNS	Local National / Local National Soldier
MiBA	Multimodal Integrated Behavior Analysis
NCO	Non-Commissioned Officer
NPC	Non-Player Character
PD	Pedagogical Director
SIFT	Smart Information Flow Technologies
SIU	Social Interaction Unit
SME	Subject-Matter Expert
SP	Social Pragmatics
SS	Social Simulator
SSIM	Strategic Social Interaction Modules
TA1, 2, 3	Technical Area 1, 2, 3
UCSC	University of California, Santa Cruz
USA	United States of America
VC	Virtual Character
VR	Virtual Reality
WME	Working Memory Element

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13.3 SIFT Final Report

SIFT Final Report Begins on the Next Page

Body Behaviors and SIFT's Etiquette Engine™

Final Report for the SIFT's subcontract to BBN/Raytheon in support of

Prime Contract No. W911NF-12-C-0002
BBN Ref ID # 14075
DPAS Rating: NONE

Prepared by: **Chris Miller and Sonja Schmer-Galunder**

File name: **SIFT-SSIM-Report-v08-fin**

1. Document History

Version	Prepared	Description
.0	8/1/14	Initial draft, primarily drafting the structure of the document
.1	8/12/2014	Chris added section 8.1 Simple Case Scenario
.2	9/24/2014	Sonja reviews section 8.1 and 8.2 Sonja adds some text from literature review
.3	10/30/2014	Sonja writes section 7 – organization of nonverbal behaviors and politeness model, 3 types of behaviors: posture, gaze, smile
.4	11/2/14	Folded in Chris's additions to section 8.2, which had been developed in a parallel document. Plus a little clean up of first section.
.5	11/7/14	Cleaned up section 7. Started on section 8.
.6	11/20/14	New version, since v05 seemed corrupt. Sonja finished integration of "nonverbal behavior" at the end of section 7 (which should be moved to section 8.) Chris added a bunch of texts from prior documents to the end of section 5 and in section 6. Just raw text swatches, not integrated or edited. Certainly internally redundant, and maybe redundant with stuff in section 5.
.7	11/24/14	Sonja made edits to section 6. And checked cross-references and reference doubles.
.8-fin	1/12/2014	Final edits to document.

2. Overview and scope

The goal of this document is capture how to represent non- or extra-verbal "body behaviors (e.g., posture, movement, gesture, facial expressions, verbal prosody, tone and volume, etc.) within the framework SIFT initially developed for verbal interactions in our Etiquette Engine™, initially developed as an adjunct to DARPA's DARWARS projects.

3. Background and Outline

The Etiquette Engine (which will be described in more depth below) was a computational instantiation and elaboration of Brown and Levinson's [1] theoretical model of politeness and its role in shaping and managing interpersonal relationships. It was based primarily on verbal expressions in discourse and relied primarily on word usage in utterances to trigger and compute effects in the turn taking typical of dialogue. The goal of this work is to explore how the Etiquette Engine might be expanded, both in terms of its underlying

theory and in terms of its computational representation, to incorporate non- and extra-verbal behaviors. We will collectively refer to these as "body behaviors".

We expect core challenges to include:

1. *The need to address the continuous nature of body behaviors*—Most verbal behaviors are largely discretized in time by the turn taking nature of discourse. That is, one person speaks and that utterance contains linguistic tokens, and finishes largely before another person begins. Thus, verbal politeness behaviors have a more nearly fixed point and duration in time. Many body behaviors (especially fully non-verbal ones) can persist over multiple utterances, and can be maintained during the Other's "turn".

2. The need to provide cross-cultural scores for the "redressive value" of body behaviors—As will be discussed in more detail below, the Etiquette Engine (EE) operated by detecting known verbal politeness behaviors from a pre-defined, culture-specific data base which also included an expected "redressive value" for that behavior—a representation of its "potency" to give or ameliorate offense within the culture. While defining and scoring such behaviors for the data bases was a non-trivial task, we were greatly facilitated in that task by the prior work of Brown and Levinson. They had developed what amounts to a taxonomy of culturally universal linguistic redressive behaviors, divided into a few larger "families" and had suggested a culturally universal redressive value for each family or type. While this left the task of discovering and representing characteristic ways of realizing those universal types in each culture we created a data base so, that work could progress in accordance with the taxonomic structure Brown and Levinson provided. No such structure exists (to the best of our knowledge) for body behaviors. Thus, we will face the challenge of suggesting one—either by reference to Brown and Levinson's structure for verbal behaviors or through some other structure we identify or create.

3. *The need to incorporate context*—An initial perception is that interpretation of body behaviors are far more determined by context than that of linguistic behaviors. A slouch may be indicative of lack of respect unless it is being performed by an individual carrying a heavy load, or wounded, etc. By contrast, the presence or absence of a "sir" (as in "yes, sir!") is less subject to modification by contextual factors—though it is not immune to them.

We are not, in this work, attempting to solve the problem of recognizing or generating body behaviors in real human behaviors or avatars. Similarly, we are not tackling the overall problem of how the detection of a behavior might affect the attitudes or decision-making or an agent, or why the agent might want to produce a specific body behavior at a given time. Instead, as with our earlier EE, we are thinking toward a computational module that can take such behaviors as input from another system, reason about and report on their perceived threat or reward—and do similar reasoning about a set of candidate behaviors that might be produced in response.

The rest of this document is structured as follows:

- First, in section 4. we introduce the Brown and Levinson Politeness model and theory, since it underpins much of our prior thinking and sets the stage for what we will be working toward here.

- Next, in section 5, we describe SIFT's prior implementation of the Brown and Levinson model in a computational approach to scoring perceived politeness of, primarily, utterances in the Etiquette Engine™.

- In section 6, we describe two prior implementations of the Etiquette Engine we have made within a broader simulation or software context: These efforts provide some guidance as to how to fold the etiquette and face-based reasoning of the EE into both a broader simulation environment and a broader model of agent goals, etc. Thus, they may provide useful background for achieving similar integration of reasoning about body behaviors.

- Next, in section 7, we will review literature on cross cultural body behaviors and their relevance to the kinds of dimensions represented in our EE.

- In section 8, we will propose methods for altering the core representation used in the EE to incorporate body behaviors.

- Finally, in section 9, we will work an example illustrating how body behaviors may be represented and reasoned about using the modified EE approach.

- Section 10 provides brief conclusions and summarizes our results.

4. The Brown and Levinson Model of Politeness

Brown and Levinson [1], through extensive cross cultural socio-linguistic analysis, developed a "functional" model of the role of politeness in all human discourse. The model assumes that social actors are motivated by a set of wants including important social wants based on the concept of "face" [2] or, loosely, the "positive social value a person effectively claims for himself" (cf. Cassell and Bickmore, 2003, p. 6, [3]). Face can be "saved" or lost, and it can be threatened or conserved in social interactions. Virtually all interactions between social agents involve some degree of threat to the participants' face—what Brown and Levinson call Face Threatening Acts (FTAs). My simple act of speaking to you, regardless of the content of my words, places a demand on your attention that threatens your face. If I simply state my desire that you give me the salt as bald propositional content (e.g., "Give me the salt") I may efficiently communicate my desire, but I have also been ambiguous about whether or not I have the power or right or can otherwise compel you to give me salt. You might well take offense at the implication that I could demand salt from you, and in this way, I would have threatened your face.

The "please" in the example above is an example of a politeness strategy used to "redress" or mitigate the threat or imposition contained in the request. Furthermore, the expectation that such a strategy be used in certain contexts is an example of etiquette that enables interpretations. The etiquette which we believe to be in play entitles us to conclude that those who use "please" in an appropriate context are striving to play by the rules—striving to be seen as polite; those who do not are not striving to be polite for various reasons (perhaps they don't believe they need to be, perhaps their notions about politeness are different, perhaps they are just rude.)

The core of the model is the claim that the face threat posed by an act is provided by the function:

$$W_x = D(S,H) + P(H,S) + R_x$$

- Wx is the 'weightiness' or severity of the FTA
- D(S,H) is the social distance between the speaker (S) and the hearer (H). Social distance is roughly equivalent to familiarity—it increases with contact and interaction, but may also with be based on a priori factors such as membership in the same family, clan or organization.
- P(H,S) is the relative power that H has over S. Power comes from different sources in different cultures and organizations. Non-player characters (NPCs) representing commanders, subordinates, or high or low status citizens might all need to act, and to be handled according to different etiquettes if face threats are to be minimized.
- Rx is the ranked imposition of the raw act itself. Some degree of imposition is culturally defined—it may be inherently more of an imposition to request food from a host in Western culture than in an Arabic one, for example. But imposition is also dependent upon the roles and duties of the parties involved.

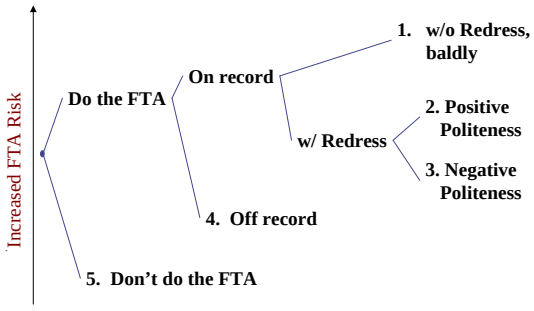


Figure 1. Universal FTA Redress strategies ranked by Brown and Levinson, (1987).

Since FTAs are potentially disruptive to human-human relationships, and since we generally wish to avoid disruption, we make use of redressive strategies to mitigate the degree of face threat imposed by our actions. Brown and Levinson offer an extensive catalogue of universal strategies for redress, organized according to 5 broad strategies. These are illustrated in Figure **1** ranked from least to most threatening. The least threatening approach, obviously, is simply not to do the FTA, and this is sometimes the only acceptable strategy in a cultural context. If one is to do the FTA at all, then the least threatening way to do it is "off record". Off record FTA strategies are means of doing the act with a sort of "plausible deniability" by means of innuendo and hints. If one does the FTA overtly, then one can still undercut its degree of threat by offering redress aimed at either positive or negative face. Negative redressive strategies focus on H's needs for independence of action and attention. They minimize the impact on H by being direct and simple in making the request, offering apologies and deference, minimizing the magnitude of the imposition and/or explicitly incurring a debt. Positive redressive strategies target the hearer's desire that his/her needs and wants be seen as desirable. These strategies emphasize common ground between S and H by noticing and attending to H, by invoking in-group identity, by joking and assuming agreement and/or by explicitly offering rewards/promises. Finally, the most threatening way of performing an FTA is "baldly, on record" and without any form of redress.

Brown and Levinson's model doesn't stop at that level, however. For positive and negative redressive and off record strategies, they offer a host of well-researched

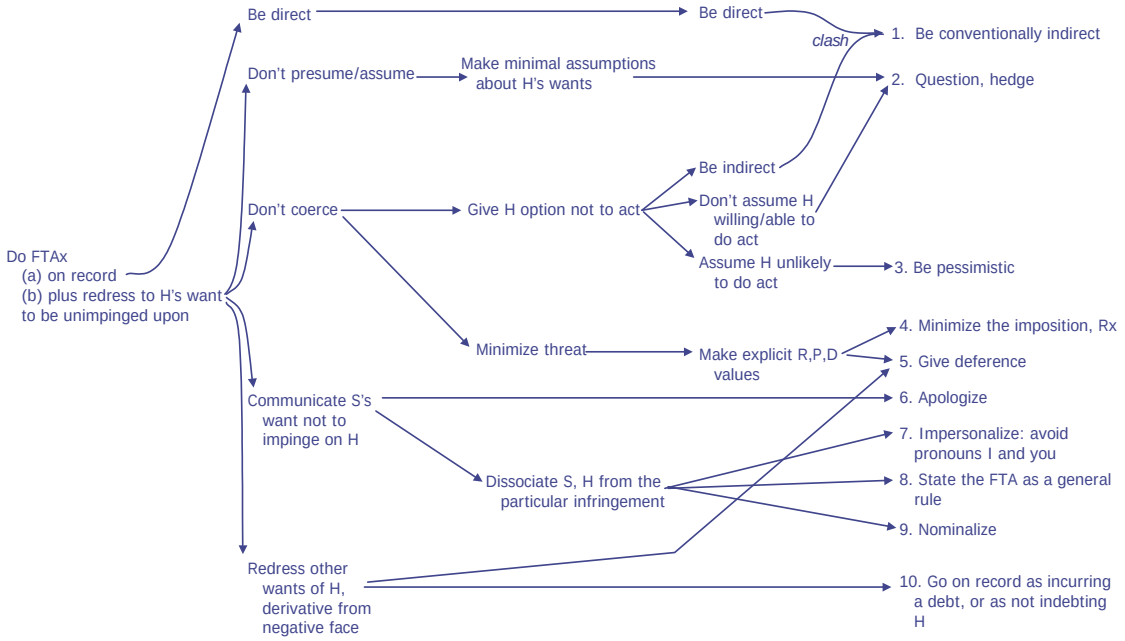


Figure 2. Specific negative politeness strategies identified by Brown and Levinson (1987), their rationale and relationships.

examples from at least three different language/culture groups (English, Tamil and Tzeltal) organized and abstracted into a universal structure of mutually supporting and incompatible approaches. Their organizational structure for ten different negative redress strategies is presented in Figure 2 as an example. Note again that these are abstract, culture-independent strategies whose relative utility is captured by the model in Figure 1, though they may well need a culture-specific instantiation prior to use—for example, the specific behaviors that count as an "apology" may well differ from culture to culture, but the basic utility of using an apology will hold across cultures.

5. SIFT's Implementation of Brown and Levinson in the Etiquette Engine™

5.1 Our Modifications and Use of the Model

Brown and Levinson's work provides us with a rich, universal model of how and why specific acts are seen as polite or impolite, as well as abstract, culturally universal strategies for steering the perception of an act toward either politeness or impoliteness. Furthermore, it provides us with variables of social interaction (D, P, and R) that serve to either mandate a specific level of politeness, or about which inferences can be made given an observed level of politeness. In 2004-2007, we were engaged in a pair of DARPA-sponsored projects under the direction of Dr. Ralph Chatham to quantify this model, make it computational and to evaluate its predictive power. Our vision, ultimately, was to use this model for generating adaptive social etiquette behaviors in a Non-Player Character (NPC) of a given cultural background in a given context (where context can include variable aspects of familiarity, power relationships and imposition—the D, P and R described above).

In the earlier of these two projects, we refocused the Brown and Levinson model on making predictions about how believable the behaviors of an NPC will appear to an observer. To do this, we implemented a quantified, computational version of the Brown and Levinson equation that used perceived aspects of context (D, P and R, as well as known history about the character, C, of the actors) to predict an expected level of redressive behaviors from an NPC actor. NPCs which do not exhibit the expected degree of polite redress (either by being over or under polite) were expected to be seen as either unbelievable or to invite rethinking of what was previously understood about the D,P,R and C of the context. For example, if a private bursts in on his captain and screams out a warning without a salute, an observer might well assume that the degree of imposition (R) is less than might otherwise be the case because the private was charged with providing such warnings or expects it to be in the captain's best interests to hear.

During this prior research, we developed specific scenarios which were pertinent to the gaming environment under development by Dr. Lewis Johnson at the Center for Advanced Research in Technology for Education (CARTE) at the University of Southern California. The gaming environment was the Tactical Language Training System (TLTS) sponsored by the DARPA DARWARs project as a game-based approach to simple foreign language training (see also section 7 for more details). While makes extensive use of a graphical environment and of speech recognition and speech generation, we believed that it did not contain a generative model of social interactions or politeness (though this turned out to be only partly true). Our test scenarios involved specific and controlled manipulations of the politeness variables P, D, R and C and specific redressive behaviors exhibited by the game's NPC characters. Our scenarios took the form of written texts and they were designed (according to our expectations) to embody specific predictions from the Brown and Levinson model:

- High Face Threat and High Redress—which should be balanced and yield nominal (believable) politeness
- High Face Threat and Low Redress, which should result in unredressed threat and therefore be perceived as rude
- Low Face Threat and High Redress, which should result in more redress than is needed to redress the face threat and, therefore, be perceived as over-polite.
- Low Face Threat and Low Redress, which should also be balanced and be perceived as nominally polite and, therefore, believable.

Two versions of these scenarios were scored using our quantitative etiquette algorithm. The results were shown to track the predicted design of the scenarios exactly: Scenarios that were expected to exhibit nominal, believable politeness levels achieved low scores, all near zero. Scenarios that were expected to exhibit excessive politeness achieved high scores, all substantially larger than 100. Scenarios expected to be seen as rude all achieved very low scores, substantially smaller than -100 (cf. [4]). This scoring example will be presented in more detail below, as it will serve as the basis of our novel work on this project.

Thus, the specific product of our SBIR was a partially-validated computational approach to scoring the imbalance of politeness usages in a social interaction context and, therefore, of computing the degree to which a given utterance would be perceived as polite, rude or nominal *in context*—that is, by a given observer, potentially from a

specific culture, observing the utterance being said by a given speaker to a given hearer, all with implications for the various terms in the model described above. This module could be used to score observed behavior or, through evaluating alternate proposed behaviors, to inform the selection of desired behaviors for different goals or ends. This means that it could be used, *as a general, reusable, computational algorithm*, to equip an NPC with the ability to detect when they are being addressed with more or less redressive behaviors than they should expect given what they know about P, D and R within their social context, and therefore, to reactively take offense or take advantage. Similarly, it could be used to equip NPCs with the ability (again, in a reusable, algorithmic form) to determine appropriate behaviors for them to exhibit in order to further their ends. In a game-based training context, this means precisely that the NPCs can make use of this reusable etiquette module to behave believably in their social interaction with human players. If the player is offensive, the NPC will take offense and will react either by ascribing to the player's actions more power (P), less familiarity (D) or lower imposition (R) and therefore, may react by providing more respectful behaviors (i.e., more redress) in return, or by asserting increased power and less familiarity in response—and decreasing redressive behaviors. Alternatively, if the player is polite, the NPC may assume s/he is claiming less power, more familiarity or a greater imposition, and may react with more cooperation and politeness or may assume superiority over the player.

The use of Brown and Levinson's model and theory to inform a module for reasoning about social interaction behaviors guarantees (insofar as Brown and Levinson's work is correct) that the module will be universal in its reasoning about and scoring of abstract politeness "moves". As we have noted above, however, any such module will need to be equipped with culture-specific knowledge bases to enable reasoning from the observable behaviors in a culture (e.g., pursed lips or a rigid hand-to-eyebrow salute) to the abstract etiquette "moves" (and therefore, politeness implications) over which the model's parameters are scored. This has the practical implication that the general social interaction reasoning of an NPC within a game context can be effectively modularized (as illustrated in Figure 3) and, thus, large savings in game code development can be realized and/or NPCs can be developed to exhibit a larger and more sophisticated range of social interaction behaviors (as will be discussed in section 6.3 below).

5.2 "Believable" Levels of Politeness

According to the Brown and Levinson model described above, people generally want to accomplish their goals expeditiously-- and this argues for minimizing redressive strategies. But they also experience a range of social and personal pressures to not threaten the face of those they interact with (especially those with greater power or shared familiarity)-- and this argues for extensive redressive strategies. The balance between these pressures yields the selection of specific strategies in context. Brown and Levinson allude to, but don't explicitly include a factor representing the relative weighting that an individual puts on his/her own goals vs. the face goals of others-- his/her general willingness (independent of the other factors) to place others' needs first. For want of a better term, we've called this factor "character" and introduced a term for it, abbreviated as C, with the character of speaker (S) being C(S). In other words, the degree of redress that a speaker S chooses to use will be a function of the degree of face threat inherent in the act (itself a function of P,D and R) and the speaker's character C(S).

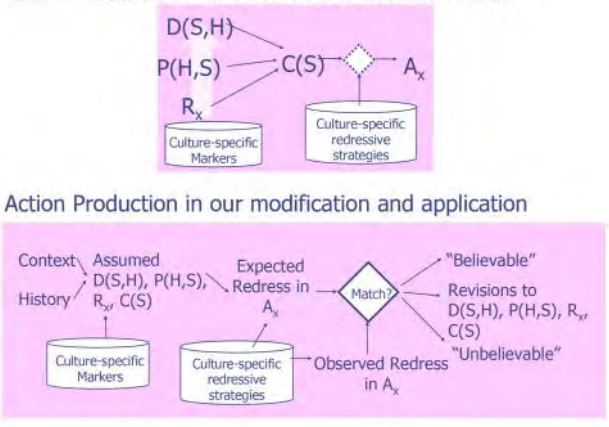


Figure 3. Graphical depiction of the Brown and Levinson model and our proposed modifications to it.

But the above description, and indeed Brown and Levinson's primary focus, is from the perspective of the speaker/actor (S) interested in achieving interaction goals and, presumably, in avoiding face threat to hearers (Hs). We can characterize Brown and Levinson's model graphically as in the top portion of Figure 3. A Speaker with a given character C(S), uses his/her knowledge of the D, P, and R of a given context and desired FTA in order to select one or more strategies from among a knowledge base of culture-specific strategies resulting in a specific action A_x which is designed to both further S's goals and to avoid undue face threat to his/her interlocutors.

In order to implement and make use of this model in believable human-computer interactions (i.e., with simulated agents), we needed to take the perspective of an observer/hearer (who may or may not be the one the speaker is actually interacting with). This perspective is represented graphically at the bottom of Figure 3. Here, an observer (O) perceives an utterance that has bald content as a speech act and may or may not contain culturally-recognized redressive strategies. O also has access to additional cues from his/her perception of the context and perhaps memory for past history. Given these cues, O's goal is to construct a picture of the "politeness" character of S and, through that, to the P, D and R of the interaction between S & H. Fundamental to our approach is the claim that this construction process is based largely on the degree of match or mismatch between the redressive strategies actually used by S (as perceived by O) and those expected by O.

Given his/her own observations or knowledge of the context, O can construct an understanding of the parameters P, D, and R. For example, if S is noticeably older, richer, or is wearing insignia that make it clear that s/he outranks H, then O might reasonably conclude that the power distance (P) between them is large and favors S. Note that the factors that affect O's interpretation of power will themselves be dependent both on O's noticing them, and on O's culture-based knowledge and interpretation of those triggers. If S and H are behaving familiarly (standing close together, interacting jovially, using nicknames, etc.), are known to be related as family members or friends, etc., then O might conclude that the social distance (D) is comparatively small between them. Finally, O will have his/her own culturally-based beliefs about the degree of imposition (R) of a given act (e.g., asking for money is a greater imposition than asking for help finding a location, which is a greater imposition than asking for the time), but observed or known characteristics of the interaction may also serve to reduce the perceived R. For example, if S is known to have a duty (perhaps based on his/her role) or a standing request to provide certain information or advice to H, or if H is not apparently engaged in any ongoing activity.

Then, given his/her beliefs about these parameters, O can construct an estimate of the degree of face threat associated with the bald content of the act. Furthermore, given whatever information s/he possess about C(S), O can adjust his/her predictions about the degree, and therefore the types, of redressive actions that s/he might expect to see used. Let us call this product the expected *redressive act* (A_x).

At the same time, O can actually perceive an observed *redressive act* (A_x). S performs an act that O will perceive as having a degree of imposition and, perhaps, various associated redressive actions. If the observed act and the expected act are the same (perhaps within certain degrees of tolerance), then the actor will be seen as believable—at least with regards to his/her/its politeness-producing etiquette behaviors.

Therefore, one metric for believability is the ***delta between the expected act and the perceived act.*** And yet, other humans fail to behave as we expect them to behave all the time without our labeling them "unbelievable". This seems to be because humans are generally aware that predicting politeness behaviors is far from an exact science. We are generally more willing to revise our beliefs about aspects of the context or character that produced our initial predictions and then reassess that prediction than we are to conclude that S is acting artificially. Thus, assessments are likely influenced by (cognitive) biases and (cultural) stereotypes.

This metric may be computed over time as well. If successive actions, with their associated degrees of redress employed, continue to violate O's notions of the NPCs' context and P,D,R and C values, O may choose to revise the assumed characteristics seeking a set of P,D,R and C values that minimizes the delta between expected and observed degrees of redress. If no such model is found, or if violations are extreme, s/he may give the game up and simply declare those behaviors to be "unbelievable".

We have not conducted extensive studies of the quantitative predictions of this model. Therefore, knowing how long it takes observers to revise their models is an empirical question that we cannot currently address. It seems quite reasonable, however, that the more data that the observer has amassed to form impressions of P,D,R and C, the more it will take to provoke a revision in those beliefs. In cases where no prior data has been amassed, we assume that observers will resort to presumed culturally-defined norms or averages (e.g., If I'm told only that "Person A" is talking to "Person B", I am likely to assume that both are of average/nominal power, neutral social distance, etc.). Note that, though extensive naturalistic analyses have not been performed by us, in one detailed analysis [5] this model was able to explain a set of naturalistic observations of sequentially occurring cross-cultural tensions between U.S. and Russian crew members on board the International Space Station.

5.3 The "Etiquette Algorithm"

We implemented a version of the Brown and Levinson equation to use as a predictive model of the believability of the redressive actions of a computerized game character (a Non Player Character or NPC) as it appears to a human observer, with perceived aspects of context (D, P and R, as well as known history about the character, C, of the actors). NPCs which do not exhibit the expected degree of polite redress (either by being over- or under-polite) were expected to be seen as either unbelievable or to invite rethinking of what was previously understood about the D,P,R and C of the context. For example, if a private bursts in on his captain and issues a bald directive ("Get your coat on") without any redress, an observer might well assume that the degree of imposition (R) is less than might otherwise be the case because the private was charged with giving such

instructions, or that the familiarity between them warranted it. Otherwise (and especially in a simulated environment), the observer might simply believe that the private was behaving "unbelievably".

Expanding on the Brown and Levinson equation for Face Threat, as presented above, our implementation uses weights on each component to allow the possibility to value D, P, and R differently (a factor we suspect may underlie some cultural differences), resulting in the equation below:

$$W_x = [w_1 \cdot D(S,H)] + [w_2 \cdot P(H,S)] + [w_3 \cdot Rx] + C(S)$$

Each Observer adds his/her own interpretations of the context. For example, D(S,H) could be expanded to $[B_H{:}w_1 \cdot B_H{:}D(S,H)]$, representing Hearer's belief about the degree of social distance and the Hearer's belief about the appropriate weight for the social distance term. We use Speaker belief (B_S:) and Observer (who could also be a Speaker or Hearer) belief (B_O:) similarly. This results in the following expansion for an Observer O:

$$B_O{:}W_x = \{[B_O{:}w_1 \cdot B_O{:}D(S,H)] + [B_O{:}w_2 \cdot B_O{:}P(H,S)] + [B_O{:}w_3 \cdot B_O{:}R_x]\} + B_O{:}C(S)$$

An implication of the Brown and Levinson model, though never overtly spelled out, is that the weightiness of the face threat must be fully compensated for, or "redressed" in normal interactions if the status quo in relationships is to be maintained. Therefore, the value of W_x should be balanced by the "value" (V) of a set of redressive actions used in the interaction x ($\mathbf{A_x}$) if the interaction is to appear "normal" or believable or without ulterior motive. In other words, we expect the value of the redressive strategies the speaker uses to equal or balance the value of the face threat s/he produces, or:

$$W_x = V(\mathbf{A_x})$$

This means that an Observer's beliefs and weightings of the social distance, power and imposition relationships, adjusted by belief about the character of the Speaker, should be balanced by the Observer's belief about the value of the set of redressive behaviors used. We express this as a difference to give us an "incredibility" or "imbalance" metric which also serves as a perceived politeness metric:

$$B_O{:}I_x = \quad B_O{:}V(\mathbf{A_x}) - B_O{:}W_x$$

In order to use this metric to evaluate the imbalance between expected and observed levels of politeness, we must operationalize the various parameters. We will summarize the basic approach to doing so below.

5.4 Operationalizing EQ Terms

In order to operationalize and quantify the Brown and Levinson model described above, we first had to develop scalar values for the various politeness parameters P,D, R and C. We proposed that the variables D(S,H), P(H,S) and Rx, as well as the various parties' perceptions of them, be represented as continuous scalar values ranging from negative to positive infinity. The value of 0 is the "balance point" or a nominal or equal value for each scale, while positive values indicate that the dimension is increased (and contributes to an increasingly "weighty" or potent FTA) and negative values indicate that it is decreased (and is, in fact, building up the Hearer rather than threatening him or her). For Power Difference of the Hearer over the Speaker (P(H,S)), for example, a value of 0 means that the power of the Hearer and the Speaker are equal, that they are (exact) peers.

Values greater than 0 indicate that the Hearer (H) has increasingly greater power (as values increase) relative to S and, therefore, that face threat increases whenever S addresses H. We proposed the following scale anchor points for nominal American culture:

- A value of -1000 is characteristic of the power that a CEO of a major company (as S) has "over" (or relative to) a janitor in his/her company (as H) or the power that a parent has over a small child.
- A value of -100 is characteristic of the power that a professor has relative to a freshman student or a parent over an early teenage child.
- A value of -10 is characteristic of the power that a project manager in an informal research team has over project members, or the power that a parent has over an older teenager.
- A value of 0 is characteristic of equal power between S and H; no or negligible difference—for example, the power relationship between two co-workers at the same level and seniority.
- A value of 10 is characteristic of the inverse of the power described for -10 above—the power that an older teenager or work team project member as S would have over (or relative to) a parent or project manage, as H, respectively.
- Etc.

Similar scales were developed for D(S,H) and Rx. The character term (C) was represented as a simple value added or subtracted from the W_x sum.

The assigning of a specific value within these scales was something of an "best judgment" by an engineer, supported through discussions with a subject matter expert in the language and culture. We have not yet had the time or opportunity to collect sufficient data in any specific culture or context to refine the scales appropriately. The fact that they work as well as they do currently is a testament to the robustness of the model.

Next, we developed numerical valuations for various redressive behaviors based on the guidelines provided by Brown and Levinson as depicted in **Figure 1** (illustrating the various redressive values of broad classes of redressive strategies) above. Ranges of values for the broad classes of strategies were defined as follows, with individual strategies within each class being assigned a value within the designated range:

- The value of the use of an individual positive redressive strategy (see Brown and Levinson, p. 102, Figure 3, for a list of such strategies) will provide from 1 to 40 "units" of redress.
- The value of the use of an individual negative redressive strategy (see Brown and Levinson, p. 131, Figure 4, for a list of such strategies) will provide from 20 to 60 units of redress.

Within the range defined above, a specific score was assigned to individual instances of redress which fell into the category, as will be illustrated below.

The effects of multiple redressive strategies were scored as simply additive. We understand that this is a simplification, and that the efficacy of added redressive behaviors probably falls off, eventually becoming simply irritating. This means that the

value V of a set of N redressive actions A contained in interaction x is given by the function:

$$V(\mathbf{A}_x) = V(\mathbf{A}_1) + V(\mathbf{A}_2) + \quad V(\mathbf{A}_N)$$

5.5 Evaluation Test Cases

This approach was then tested in a series of sample social interaction vignettes crafted to represent (according to our American cultural intuitions) either normal/balanced politeness, excessive over-politeness or excessive rudeness. Our goal was to determine if the equation and scoring techniques we had developed would track our intuitions for scenarios in which politeness was balanced or imbalanced in various ways. The level of face threat and redress were varied over this set of vignettes so that high face threat situations were paired with high levels of redress (which should produce roughly normal, balanced levels of redress) as well as low levels of redress (which should be highly imbalanced and perceived as very rude—perhaps unbelievably so). Similarly, very low levels of face threat were paired with very high levels of redress (which should be perceived as over-polite, perhaps unbelievably so) and with low levels of redress (which should be perceived as balanced and fully believable). Examples of two such vignettes are illustrated below, followed by our reasoning through the application of the above scales and valuations to those scenarios:

> Vignette 1 —*High Face Threat, High Redress, High Believability*: A low ranking soldier (i.e., a corporal, as indicated by uniform insignia) walks into the Mayor's office and the Mayor motions him quickly to a seat. The soldier takes off his hat and sits down, waiting while the Mayor continues to write something. The Mayor finishes up writing, puts down his pen and looks up at the soldier expectantly. The soldier then says, "I'm sorry to interrupt your work, Mayor Fredrickson, but my name is Corporal Jones and I've been put in charge of your escort to the event tonight. I was wondering if it would be possible for you to let me know where I can meet your wife so that I can get her there on time?"
>
> Vignette 2—*High Face Threat, Low Redress, Low Believability*: As for vignette 1 above except that the soldier acts and speaks differently. Here, he interrupts the mayor while he is speaking, perhaps by putting a hand on his shoulder, and says loudly, "Tell me where I can meet your wife?"

Each of the eight vignettes was then assessed using the operational scoring tables we had created. For example, for the first vignette the imbalance evaluation proceeded as follows:

- The corporal (as S) has lower power than the mayor by a fairly large degree. That is, his "power difference" relative to the mayor is fairly large—perhaps slightly larger than our anchor point of 100, yet less than the anchor point of 1000. We scored that as P(H,S) = 300 (and, since there were no cultural differences or speaker or observer misperceptions B_O:P(H,S) = 300).
- There is no particular familiarity between the two individuals in this vignette, but social distance is not extreme either. They are from slightly different "cultures" (military vs. civilian infrastructures) and show no evidence of prior relationship, but they are engaged in a common endeavor. The social distance between them is probably only slightly higher than 0. Thus, D(S,H) = 3.
- The imposition of this request could be somewhat large. To ask after the location of one's wife so as to pick her up is comparatively threatening, though the fact

that this is in the mayor's service should mitigate this imposition (as the corporal reminds him). The raw imposition is a short answer required from the mayor, characteristic of our level 10, so we assigned it: Rx = 10.

- Since we have provided no reason to believe that the character of the corporal is anything other than nominal, we will assume that C=0.

This gives us a value of B_O:W_x as supplied by the left hand portion of the equation above as:

$$3 + 300 + 10 = 313$$

For the value of the redress applied $V(A_x)$ we identified and scored the set of redressive actions in Table 1.

Thus, the imbalance score for this vignette, as calculated by the equation, would be: 295 – 313 = -18. Since this vignette was intended to convey both high face threat and high redress and, thus, to be balanced and believable, this score seems to be about right, falling very near zero.

For the second vignette, by contrast, we have a high degree of face threat with virtually no redressive actions. This is unexpected and should be perceived as very rude. This scenario should have a score much less than 0 on our imbalance metric—indicating that there is substantial unredressed threat. This vignette was scored as illustrated in Table 2.

Table 1. Redressive actions scored in Vignette 1.

Action and Interpretation	Score
1. The soldier waits until the mayor is finished and invites him to speak. This seems to be a very explicit form of negative politeness (putting the other's interests first) and, especially in this instance where the H was not actively engaged in another conversation, seems very potent.	60
2. The soldier takes off his hat. This is a sign of deference in our culture, which is in turn a fairly potent negative politeness strategy.	50
3. The soldier apologizes for interrupting. This is also a negative politeness strategy, though arguably a less potent one (though that may be highly mitigated by facial expressions and body language).	30
4. The soldier uses an honorific. Moderately potent negative politeness strategy.	40
5. The soldier poses the FTA as a question. Common negative politeness strategy.	20
6. The soldier offers an explanation/reason for needing the information. Positive politeness strategy, seems particularly powerful in this case.	35
7. The soldier appeals to the Mayor's (H's) interests. Positive politeness strategy Powerful in this context.	30
8. The soldier is hesitant and skeptical about compliance. A common but reasonably potent negative politeness strategy.	30
TOTAL	295

Table 2. Redressive actions scored in Vignette 2.

Action and Interpretation	Score
1. The soldier is very brief and therefore, takes little of the mayor's time. This could be counted as a negative politeness strategy of directness (albeit not a very effective or unambiguous one).	30
2. This could perhaps also be counted as an example of the positive politeness strategy of optimism and assumed compliance—though again, not unambiguously.	10
TOTAL	40

For the degree of face threat (Wx), we scored the following:

- The power relationship is identical to the above P(S,H) = 300.
- The social distance between them should also be identical to the above.
- The imposition of this request could be large, especially in the absence of the reminder that it is in the mayor's interest, but it remains essentially the same request as in the previous vignette. Thus, we keep the "raw" imposition score the same: Rx = 10.

Thus, the imbalance score for this vignette would be: 40 - 313 = -273. This again seems to be about right—a score much less than zero for a vignette that was intended to include much more threat than redress.

An evaluation similar to that described above was carried out for a total of eight vignettes and the quantitative algorithm tracked predictions for rude, polite or nominal perceived etiquette levels very closely. As shown in **Figure 4** all vignettes that were intended as "nominal" interactions (that is, using about the amount of redress as would be expected in American culture for the amount of redress offered) scored within +/- 100 points of zero. All vignettes that were expected to be seen as over-polite scored well higher than 100 points; while all that were expected to be seen as overly rude scored substantially less

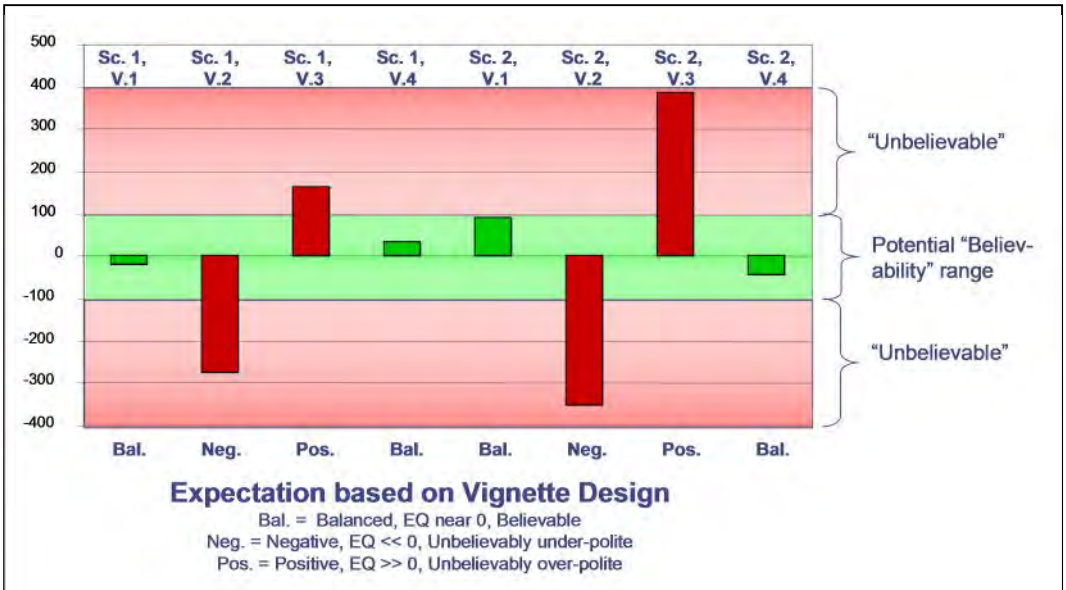


Figure 4. Imbalance scores for 8 vignettes together with expectations.

than -100 points.

While the above example was based on one individual's scoring assessments (Dr. Miller's), we have since replicated this work with two other "raters" following a brief training session from Dr. Miller. Each rater then scored the vignettes according to the guidelines as described above (and in more detail in our training documentation). The results of the three raters' scores for the eight etiquette scenarios were then statistically compared. The top-level imbalance metric (Ix) showed a Robinson's A correlation of .931 among the three raters across the 8 vignettes, and the two major subfactors (Face Threat Weight—W_x and composite Redress Value—$V(\mathbf{A}_x)$) the Robinson's A correlations were.950 and .863 respectively. These values are all well above traditional correlation thresholds of .7 or .8 for multiple judge rating correlations. Thus, this study lends weight to the belief that we have identified a reliable method of scoring the degree of politeness vs. expectations in social discourse—at least within an American cultural setting.

While the above evaluation used trained raters, familiar with both the Brown and Levinson theory and with our own assumptions about how to rate redress and threat behaviors, we subsequently conducted an experiment wherein 22 American college students (respondents to flyers and unaware of our theory or model), also rated the same 8 vignettes. Participants reviewed a "backstory" describing the participants in the vignette and then answered a series of questions about their relationships. They then read the specific, verbal interaction (i.e., utterance), and answered (using Likert scales) questions about their perceptions of the actors, their relationships, the degree of politeness used and whether or not they regarded the interaction as normal, rude or overly polite.

Correlations between participants' ratings of the model parameters and our own remained very high. Comparing the project team's mean rating with the untrained participants' mean rating using Pearson's coefficient showed correlations of .867 for power ratings, .881 for social distance, .766 for imposition and .892 for overall imbalance/politeness ratings. The overall politeness correlation was significant at the $p<.01$ level (two-tailed).

Participants were also asked whether they changed beliefs about the power and social distance values after they had seen the utterances used. Since some vignettes used utterances expected to be nominal while others used either unexpectedly high or low politeness levels, we hypothesized that if our model were correct, then more participants would be willing to change their ratings after seeing the vignettes with "off-nominal" politeness rather than those with nominal politeness.

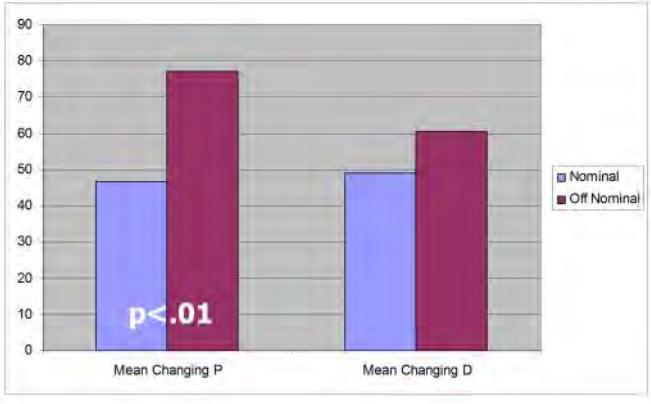


Figure 5. Percentage of participants wanting to change their estimates of Power Difference (P) and Social Distance (D) after hearing the actors' utterances.

As shown in Figure **5** a higher percentage of participants reported

willingness to change their ratings in response to the off-nominal vignettes, though this effect was more pronounced for Power Difference (P) than for Social Distance (D) ratings. A paired-samples t-test on the mean values for the four nominal vs. four off-nominal vignettes showed that significantly more participants wanted to change their estimate of Power Difference after reading/viewing the Off-nominal behaviors than the Nominal ones ($t=-4.85$, $df=3$, $p<.05$). A similar test for the Social Distance parameter was not significant ($t=-1.186$, $df=3$, $p>.2$) but trended in the same direction.

In general, these data support our interpretation and implementation of Brown and Levinson's model and the claims that unexpected (i.e., off-nominal) amounts of redress prompt people to reinterpret their beliefs about context—specifically, their beliefs about the power and social distance parameters. In this study, participants proved more willing to review their perceptions of power relationships than social distance. This may be a function of the marked power relationships in the vignettes (involving, as they did, soldiers and civilians) or it may reflect a more general tendency among Americans to seek explanations for politeness variations in power dimensions first.

6. Implementing the Etiquette Algorithm

We have been developing the concept of computational and machine representations of human face threat, redress, etiquette and politeness under IR&D since 2001. In this section we describe the successful application of the etiquette algorithm in a variety of military-relevant contexts, along with some of the features which, we believe, make it useful for future applications.

For example, in 2004 we began our work with the Brown and Levinson theory by creating and evaluating the reminder texts for an in-home medication reminding system for Honeywell. Subsequently, SIFT and our partner, Dr. Lewis Johnson (then at USC's CARTE labs), won and completed Phase I of DARPA SBIR SB041-009 under Dr. Ralph Chatham, as PM. In this work we developed a "believability metric" for assessing and predicting when a given level of redressive behavior from a computerized game character would be perceived as "unbelievable" by a human player or observer. Our approach yielded the face threat and redress algorithm described above. We completed this work with a successful evaluation of believability predictions over a set of scenarios whose degree of "believability" we had systematically varied to have high, low or believable amounts of redress (see Figure 4. in section 5.5).

In work funded by DARPA under the Force Multipliers for Urban Operations program (BAA 04-031, Dr. Ralph Chatham again as PM), we completed an implementation and demonstration of an algorithm based on Brown and Levinson's work as described above. Our demonstration illustrated the use of this algorithm in the context of a language training game in which it enabled characters to both recognize the degree of politeness directed at them and to reason about the level of politeness to be used in an interaction they themselves issue in keeping with other goals the character may have. We used swappable culture-modules: libraries of culture-specific behavior evaluations enabling serious game characters to both generate and recognize the threat values of communicative moves [7]. The results of this work give us the ability to represent alternate cultural perspectives by swapping knowledge bases (including body behaviors) thereby dramatically reducing the cost and effort of developing character behavior.

This work led to the further development of the Interactive Phrasebook, described above (SBIR OSD06-CR5), completed in 2007. The interactive Phrasebook made use of our existing

etiquette algorithm and embeded it in a broadly applicable mission rehearsal tool for cross-cultural interactions.

Subsequent work in this area (completed in 2009 under SBIR AF06-069) took our social interaction representations and applied them in a series of human experiments to determine how variations in politeness interact with cultural differences to predict compliance attitudes and behaviors (trust, affect, reaction time, accuracy) in response to directives: instructions, orders, requests, etc. [6]. This work provides rich empirical data to support and extend our interaction perception models to adaptable culture specific models of behavior and action.

Next, we will explain details from some of these projects and highlight the implications for SSIM.

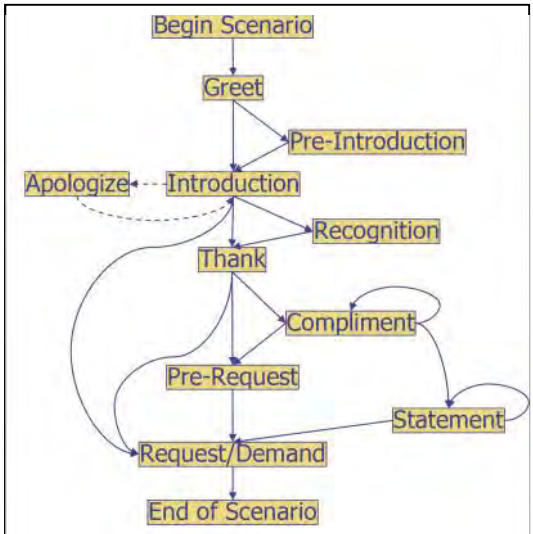


Figure 6. Trainee pathway for an "Ask a favor" scenario or "micro-game".

6.1 Example of interaction in Pashtun cultural context

As mentioned above, our model extends politeness perceptions to incorporate culture-specific effects on attitudes, perceptions and, ultimately, the behaviors of an observer. The computational implementations of our model have not only proven valid at tracking perceived politeness in American cultural contexts [4], but also adequately representing Pashtun and Iraqi cultural interactions [7]. We will explain a partial example (drawn from the Pashtun culture, as incorporated in a language and culture training game) to clarify our approach. Note that a video demo of our EtiquetteEngineTM for this scenario is available at http://www.sift.net/demos/etiquette-quotient.

Say a trainee has the role of a sergeant whose mission is to enlist the aid of a local village headman (the "Malek") in building a clinic. This interaction might be viewed as a specific instance of a general scenario type—an "Ask a Favor" interaction. Figure 6. illustrates the anticipated interaction moves that the trainee will/may make in preparing to ask a favor. This structure is not a strict pathway. Not only are there multiple branching points, but each block represents a wide variety of possible communicative behaviors as described below. The trainee's "moves" could be constrained, by the game, to fall into the particular types represented, or a more freeform approach might be implemented—but these represent the moves that the Malek will expect, and also those that the designer has deemed important for training in this scenario. Which specific combinations of phrases, gestures, posture, prosody, etc. the trainee chooses to use at each step in the scenario will influence the Malek's response and, hence, the course of a particular "run" through the scenario.

Note that these "moves" and their framework as a pathway for an "Ask a Favor" scenario represent a precursor to the "micro-games" concept we develop somewhat further in section 9 below.

Consider the "Recognition" step in this path. Let's assume that they have just met and exchanged a round of initial greetings and introductions. After being introduced, the trainee "recognizes" the introduction by choosing a communicative act including the

phrase “staasee de lidelo tsexa xoshala shwem, saaheb” with a double-handed handshake gesture—meaning, “I’m very happy to meet you, sir” with a very warm and friendly gesture and facial expression. In order to score the Malek’s interpretation of this interaction, we need to know what the Malek thinks about the power and familiarity relationship between himself and the trainee, his perception about the imposition of this type of communicative move (a “recognition”) at this point in an interaction thread, and finally, his understanding of the various redressive behaviors which might be used and their relative values.

P, D, R and C are scored on +/-1000 point scales we described in section 5.4 above. Their application to this example was as follows:

- The Malek believes he has slightly more power than the trainee does (P = 20)
- The Malek believes that he and the trainee are not quite as distant as complete strangers would be—they have mutual acquaintances and a mutual objective (D = 15)
- There is a very slight imposition to the trainee taking the initiative in offering his RECOGNITION speech act before the Malek recognizes him, but this value isn’t large in this culture at this stage of the conversation (R=5).

The trainee used several polite redressive strategies here. The values and scores for these are:

- 10 points of redressive value for the use of an exaggerate approval strategy (a type of positive redress): “I’m very happy to meet you, sir.”
- 15 points for the double-handed handshake gesture.
- 20 points of redressive value for the use of formality, a form of giving deference, a negative redress strategy: (this greeting is much more formal and uses formal pronouns than other possible ones)
- 20 points of redress for an honorific, a negative redress strategy: “I’m very happy to meet you, sir.”

Given these values, we can compute the Malek’s perception of this exchange using the equations described in 5.3 above.

$$B_O{:}I_x = B_O{:}V(\mathbf{A_x}) - B_O{:}W_x$$
$$B_O{:}I_x = (15+30+20+25) - (20+15+5+0)$$
$$B_O{:}I_x = 100 - 40 = 60$$

The Imbalance value of 60 is moderately over-polite—characteristic of something a bit warmer than the Malek would have expected from the Trainee, but not so extreme as to make him question interpretations and motives. It should also be noted that the score would be lower if body behaviors would not be taken into consideration. In fact, this exchange is likely to put him into a good frame of mind for future negotiations. Nearer term, the Malek will choose his next utterance in his scenario pathway (not shown) so as to match the politeness that the Trainee has shown him.

Note that scores such as those listed above are not just “best judgment” on the part of a designer. We have reduced our techniques to a coding manual, and the approach has been tested for small data sets across three cultural groupings (American, Iraqi and Pashto cultures) with good success. We have completed inter-rater reliability studies and compared trained raters with naive ratings from American students, obtaining

correlations of .950 and .863 respectively—as described above (cf. section 5.5 and **Figure 4**).

In practice, we obtained the values for Pashto interpretations through a series of interviews and evaluations of the algorithm's outputs conducted with a native Pashto speaker. But acquiring the knowledge to develop these knowledge bases is a process we have not formalized to any significant degree. We believe that the Brown and Levinson model, with our extensions (including a framework to score nonverbal language) and formalization of it, provides an excellent basis on which to structure efficient and reusable knowledge acquisition, and that role playing is an excellent approach to observing the use of verbal and nonverbal politeness behaviors in a reasonably realistic context, as the next example will show.

6.2 A Reusable, Model-based Framework for Cultural Knowledge

The use of Brown and Levinson's model in a module for reasoning about social interaction behaviors ensures universal reasoning about and scoring of abstract politeness "moves". The model already provides guidance to the types of redressive behaviors, the dimensions that influence face threat and even guidance about the likely relative value of different redress strategies. While scales need to be normalized and anchored for each new culture and specific data represented for the individuals, interaction moves and redressive behaviors used in each scenario, the model greatly simplifies this task. First, it provides a reusable algorithm which, in turn, identifies the dimensions which need to be captured (P, D, R and C) for each individual in a scenario and provides a taxonomy for the categories of redressive actions to be looked for in a culture – these are both verbal (e.g., apologies, honorifics, avoiding assumptions of compliance, etc.) as well as non-verbal (gaze, proximity, posture, facial expressions) actions.

Second, such knowledge, once captured, can be extensively reused. Knowing the P,D,R,C values for the Malek and the sergeant above, I can compute the Malek's perceived threat for any other interaction whose redressive moves have been characterized-- what if the sergeant failed to use the "sir" above? What if he omitted the handshake, or used a less warm single-handed gesture? What if he the sergeant wouldn't look at the Malek while speaking? What if he used a more casual recognition like "Pleased to meet ya!"? Or what if the Malek demonstrates his higher status with a dominating pose? Etc. Similarly, if a new individual is of interest, we just need to represent the pairwise P,D,R,C perceptions for the new individual and the entire scenario can be repeated. If we were interested in a scenario in which the sergeant asks a shopkeeper (lower P than the Malek) for help locating a shop selling batteries (lower imposition), all combinations of communicative moves above can be reused—and new computations will show how they affect the shopkeeper in this scenario. Once a character or communicative act is represented for one scenario, its scores can be reused for later scenarios where a designer chooses it as relevant.

Finally, any such module will need to be equipped with culture-specific knowledge bases (as illustrated conceptually in **Figure 7**), however, to enable reasoning from the observable behaviors in a culture (e.g., pursed lips or a rigid hand-to-eyebrow salute) to the abstract etiquette "moves" (and therefore, politeness implications) over which the model's parameters are scored. This has the practical implication that the general social interaction reasoning of an automated system can be effectively modularized, and, thus, large savings in simulation code development can be realized. For example, if we move from Pashtun to, say, Albanian culture, much of the knowledge described above will have

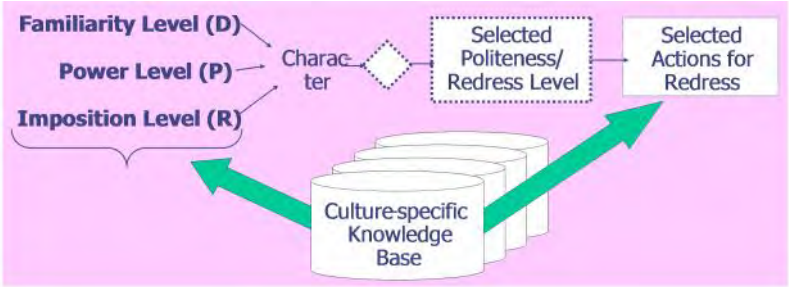


Figure 7. The role of "culture modules" of culture-specific politeness knowledge in our implementation of the Brown and Levinson model.

to be recaptured—but not all, and what is already implemented will guide and speed what needs to be learned. Sergeants will still need to ask for favors from shopkeepers and village leaders; hence the core trajectory represented in Figure 6 can be reused, perhaps with modifications to branches and specific steps. Power differences and degrees of imposition may differ somewhat (a shopkeeper may hold more or less status than in Afghanistan), and of course, specific redressive acts, body behaviors and language phrases will differ. But while the redressive value of the use of honorifics may be the same, the accompanying gestures and postures may impact the imposition in different ways.

Furthermore, basic game storylines or training modules and even specific characters can be easily transposed from one cultural milieu to another—enabling the village priest who the player had to interact with to get intelligence information in a Kosovo training game to take on the culture-specific behaviors and reactions (though not, without further work not reflected here, the appearance) of an imam in an Iraqi training game—simply by loading a new module of cultural knowledge. In each case, new knowledge bases of culture-specific politeness behaviors would need to be developed (and, of course, checked for accuracy) for each new simulation, but the core game storyline(s) and character roles, general actions, motivations, capabilities, etc., could remain unchanged.

In our implementation, this means that the core algorithm for computing perceived politeness can be used to emulate the behaviors and perceptions of any culture with no modifications. Culture-specific knowledge about redressive behaviors and their values, as well as about the factors that constitute power, social distance and imposition, can be stored in separate knowledge bases which we refer to as “cultural modules”. This architecture is depicted in Figure 7. By swapping cultural modules we can, almost literally, provide an NPC with a “brain transplant”. The game character portraying the Malek in Pakistan can, with the flick of a software switch, instead think with the perceptions and biases of a Kosovar village priest. While the construction of culture-specific modules of relevant etiquette knowledge is a non-trivial task in its own right, the framework of our model can serve to guide and limit such knowledge acquisition and representation and, once implemented, both the scaling arguments made above and the reusability of the core reasoning algorithm provide further advantages in developing believable characters representing alternate cultural backgrounds and perspectives. Granted, this does nothing to alter the graphical appearance of the character or its surroundings (arguably more resource intensive software development considerations), it nevertheless represents an important innovation which enables more cost-effective development of culture-specific emulations in gaming and training software.

6.3 Implementation of the Etiquette Algorithm into a virtual training game: Tactical Language Training System (TLTS)

Figure 8. An example of interactive characters in USC/CARTE Labs' Tactical Language Training System [8].

The implementation of the etiquette algorithm into the language training game Tactical Language Training System (developed by the University of Southern California's CARTE Laboratory [8]) demonstrated our algorithm's ability to inform both the perceptions and the reactions of simulated characters—and with less software development time than traditional scripting approaches. TLTS is a first-person game/simulation designed to teach soldiers "tactical" versions of a language (to date, Lebanese Arabic, Iraqi Arabic and Pashto, a language spoken along the Afghanistan/Pakistan border demonstrating the ability of our approach to provide at least reasonable knowledge and use of politeness levels in a culture different from American English.

The trainee navigates scenarios wherein s/he must interact with simulated local inhabitants to accomplish an overall mission: e.g., the trainee might need to ask a group of young men in a café (Figure 8.) who the leader of the village is in order to progress to the next scenario, wherein s/he will meet the village leader. By using specific phrases and gestures, the trainee must convince the young men to provide the information. TLTS uses speech recognition techniques to process the trainee's verbal utterances in the selected language, and offers a set of mouse-selectable gestures (such as taking off one's hat or sunglasses, covering one's heart, shaking hand, etc.) to accompany actions. If the trainee's Arabic is not up to the task, s/he will fail, but more than simple language skills are required. TLTS is also concerned with politeness in word and gesture. If the trainee is rude by local cultural standards, the men may well conclude that s/he is a spy and refuse to offer any information.

Here the Etiquette Engine (EE) operated in two alternate modes with TLTS, as illustrated in Figure 9. First, for a game character to recognize the level of etiquette directed at it, EE received as input from TLTS the recognized utterance (as transcribed text) from TLTS's speech recognition algorithms, along with any user-selected gestures. EE maintained a knowledge base of beliefs that each individual held that enabled it to compute the relative power and social distance between each pair of characters. A second knowledge base contained data on that character's beliefs about the relative imposition of a type of speech act and the redressive value of sets of politeness behaviors. These knowledge bases could be varied from individual to individual with inheritance for cultural groupings. By consulting the knowledge bases appropriate to the character of interest, we could determine that characters' beliefs about each of the values in the equations above and, thereby, compute a perceived imbalance score for that utterance for that character.

The second function of the EE was to recommend "communicative acts" (CACTS—combinations of verbal utterances plus non-verbal content) for characters to deliver in

accordance with their etiquette goals. The etiquette goal could be expressed as a modulation of the status quo (i.e., the character might want to be more or less polite or neutral for the current context), and

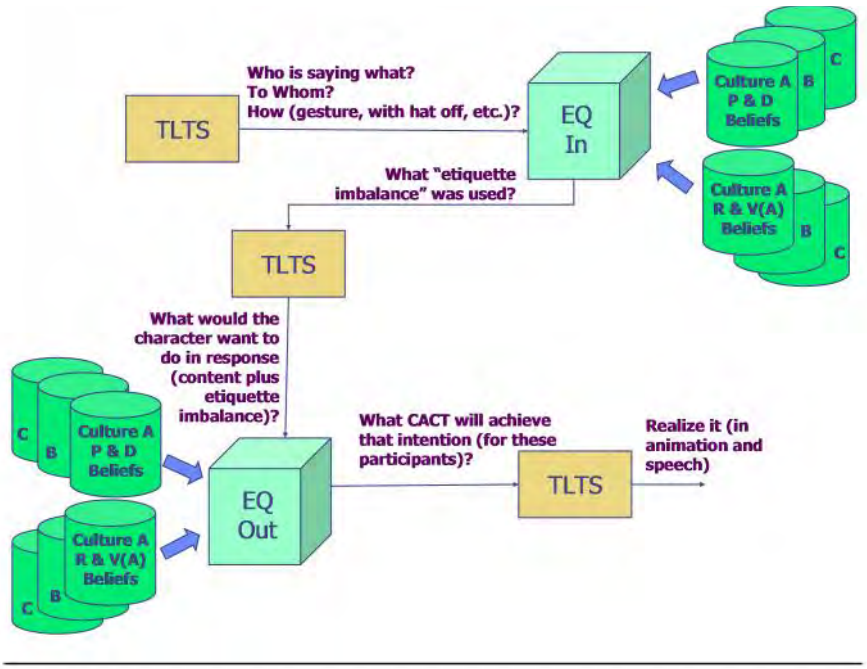


Figure 9. Architecture of SIFT's EE integrated in USC's TLTS.

therefore, could be expressed as a positive or negative imbalance number ranging from positive to negative 1000. The EE then examined alternate CACTs of the type requested (GREETING_RESPONSE) and selected or composed one whose legal combination of redressive acts was approximately equal to the desired imbalance number.

Prior to our involvement, TLTS used either a traditional scripting approach or a complex, first-principles reasoner emulating human goal-based reasoning and decision making [9]. Neither of these was an entirely satisfactory solution. Traditional scripting approaches greatly limited the range of etiquette situations which the trainee could experience because they required extensive effort to implement a range of alternatives and, in the absence of such effort, were "brittle"—that is, they provided acceptable behavior only for the narrow path of interactions which had been scripted. When novel, unscripted behaviors were attempted in the context of the game, character behaviors would either be inappropriate or absent completely. For example, while a small range of greeting and response options were encoded, it was entirely possible for the trainee to use an insult in the context of the greeting with no ill effects since the game did not recognize insult phrases. Similarly, it had limited sensitivity to the "layering" and combinatorics of politeness behaviors (e.g., using an honorific and an apology and impersonalization vs. using only an honorific).

The use of the detailed goal-based reasoning module, PsychSim, eliminated the problem of brittleness in principle, but not always in practice. PsychSim offers a rich and deep representation of human goal-based reasoning and includes a similarly deep reasoning about the intentions of other agents. This complexity, was far richer and more general than the etiquette and politeness reasoning we proposed and, thus, even less brittle. The problem was that the richness PsychSim offered resulted in a need for substantial development effort and produced comparatively unpredictable results. When development effort was not adequate, incorrect interaction behaviors could result. Even when it was adequate, however, the results were not always as controllable as was desired

for a training simulation which, after all, needed to adhere to a reasonable "lesson plan" and progression through the stages of the game.

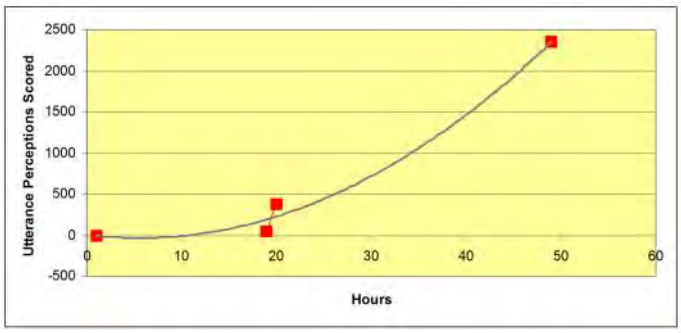


Figure 10. Scale up data for Perception Scores represented during work with TLTS.

Our Etiquette Engine represented something of a middle ground between these approaches. By parsing the perception of politeness into subcomponents (power, social distance, imposition, character and redressive values), it opens the possibility of recombining elements to greatly expand the set of possible utterances captured in a system—just as understanding vocabulary and the rules of syntax enable the construction of all possible sentences in a language. Unlike the linear scalability of traditional scripting approaches to representing social interaction behaviors in games or simulations, where each subsequent interaction must be developed from scratch with essentially the same cost in labor as the one before it, there is reason to believe that our approach scales geometrically.

In fact, during our work with the TLTS we demonstrated this scalability by acquiring the knowledge for and encoding our first set of 42 "Perception Scores" (PSs—how one observer perceives the politeness of one specific communication uttered by a specific speaker-hearer pair) at the rate of 2.33 PSs/hour, but the next set were acquired at 19.89 PSs/hour, and the final set of more than 2000 PSs were acquired at the rate of 48.96/hour. This progression is graphed in Figure 10. In short, it becomes easy to recombine previously scored elements to generate the product set of possible communicative acts each of which will then be automatically scored on the basis of those previously scored elements.

Figure 11. Sample screen from SIFT's Interactive Phrasebook-- an implementation of the Etiquette Engine designed to be used as a portable rehearsal aid.

6.4 Interactive Phrasebook

Our final major implementation effort of the Etiquette Engine and its associated computational algorithms was the Interactive Phrasebook--a prototype culture training and mission rehearsal aid developed under a previous Army SBIR. Phrasebook integrated verbal and non-verbal aspects of communication into a model-based architecture. Several candidate modifications are described below. Sample interaction screens from the prototype we developed are presented in Figure 11 and a video demonstration is available at http://www.sift.net/demos/phrasebook. Features of our Interactive Phrasebook prototype included:

- Implemented on a Hewlett Packard iPAQ PDA running the Windows CE operating system. Since the development of this prototype, mobile technology has advanced considerably. However, the suggested architecture can be relatively easy integrated in a mobile application for several current operating systems.
- Scenarios selected from library by user based on current needs.
- Scenario characters and roles selected and tuned from stock characters—variations in P, D, R and C were under the user's control and thus the basic scenario could be "tuned" (e.g., asking a big favor from an important person vs. small favor/familiar person, etc.)
- Interaction moves (including gesture, posture, prosody, etc.) were selected from menu alternatives in text (a la a theater script)—though English, Arabic phonetic transcription and Arabic script versions were available. Available utterances were synchronized to the alternate steps in the scenario (cf. Figure 6).
- Guidance for pronunciation, gesture/posture/prosody execution, etc. was available through video, audio, animation and photo files linked to potential utterances.
- Character actions can be controlled by initial attitude and attitude adjustments arising from trainee interaction selections—hence there was a bias toward using adequate, but not excessive, politeness. Our recent work [7] has provided us with multi-cultural data on the impacts of face threat and redress on trust, affect, compliance rates and reaction times, etc. These data will provide grounding for more complex character reasoning and reaction models. We are aware that obtaining compliance may be more about asserting power—perhaps through "rudeness"—and will be able to develop and convey such models.
- Ongoing feedback on perceived threat and redress can be provided from our scoring algorithm, both before each utterance/body movement selection and on an ongoing basis throughout the scenario to reflect changing attitudes.
- Reviews of our Phrasebook prototype with deploying soldiers at Ft. Polk indicated high regard for our approach. Quotes included "I think everyone should have one" (from a specialist training for his fourth tour in Iraq and Afghanistan) and "This could save lives" (from a redeploying sergeant).

6.5 Using Etiquette and Politeness "in reverse"

Our most recent work has moved away from using the etiquette model to control the behaviors or perceptions of characters in games or simulations and, instead, is focusing on using it to guide the interpretations of politeness behaviors used in human-human interactions. In work sponsored initially by the U.S. Navy [10] and subsequently and much more extensively by NASA [11], we have been using the etiquette algorithm and Brown and Levinson's politeness model as a guide to interpreting human interaction behavior for cues to the relationships that exist among the participants. In the Navy work, for example, we were able to correctly predict 100% of the core power relationships in a set of operational chat messages that took place over the course of a week during a Marine simulation exercise. While this work extends and makes continued use of the politeness scoring representations, it does not (yet) explicitly consider body behaviors and is not used in guiding simulations or game characters. Therefore, it will not be discussed further.

Instead, we will turn to a brief examination of the available literature on a core set of body behaviors for guidance as to how to incorporate these into the Etiquette Engine representation and reasoning approach.

7. Cross Cultural Body Behavior Data and Models from the Literature

As outlined above, politeness theory provides several linguistic strategies for redress (cf. Figure 4 and especially Figure 2), however nonlinguistic aspects of politeness may be equally important [2]. While Brown and Levinson focus almost entirely on linguistic manifestations of politeness, they acknowledge that nonverbal behaviors also play an important role in face threat. For example, Brown and Levinson refer to "hesitant prosodics and kinesics" (p.188) and "hedging through intonation"(p.147) as examples of manifestations of negative politeness strategies. While a number of politeness strategies can be communicated nonverbally, the connection between the strategic use of verbal and nonverbal behaviors has been mostly ignored.

However, there are several reasons why nonverbal behavior is at least as important (if not more important) than verbal expressions.

1) Much of our communication is expressed through nonverbal messages.
2) Nonverbal and verbal cues function cooperatively in a complex manner. For example, interpretations of polite utterances to save face depend not only on the semantic content, but also on the accompanying nonverbal cues. Delivering bad news (i.e. the statement "we lost.") *with a smile* or *without a smile* leads to different interpretations, even though the linguistic content is the same. Saying, "we lost" with a smile appears more optimistic and gives a sense that this is "part of life", while saying "we lost" without a smile carries more negative weight and disappointment.
3) Brown and Levinson's politeness theory originates in Goffman's conceptualization of "facework" [2] – communicative strategies used to preserve self-esteem and "face". Goffman suggest that a lot of facework occurs through expressive behavior and the nonverbal channel of communication. Interpretations of utterances that save face depend not only on the semantic content, but also on the accompanying nonverbal cues that are able to contextualize an utterance.
4) There is some evidence that nonverbal communication is more universal across cultures than linguistic communication. First, behavioral research provides strong evidence that facial expressions representing basic emotions are recognized universally [12]. Second, verbal information is embedded in different languages and words that may carry culture-specific meaning, which may be difficult to translate. However, there is also evidence that neural activity related to social interactions is impacted by differences in cultures. For example, East Asian cultures show increased neural activity in the brain regions related to inference of others' mind and emotion regulation, while Western cultures show enhanced neural activity in the brain areas related to self-relevance and emotional responses during social cognitive/affective processes [13]. In sum, nonverbal behaviors are influenced by social and cultural contexts, influence perception of politeness and need to be understood within its linguistic context in order to interpret meaning accurately.

The influence of culture on nonverbal expressions of politeness is relatively unexplored,

however some studies have investigated the effects of nonverbal behavior on perceptions of social relations. For example, vocal pitch and facial expressions have been found to vary with intent to convey politeness [14]. Nonverbal cues of politeness have been found to vary with status, depending on culture. Research suggests that when politeness strategies are expressed through different channels of communication (silent video, speech, video and audio) nonlinguistic strategy usage is related to social and contextual factors [15]. For example, cultural context is a mediating factor when choosing the appropriate politeness strategies, i.e. in low-context cultures (American) the content of the communication is more important and in high-context cultures (Korea) the relational (hierarchical) context is more important when conveying a message. Other studies using nonverbal cues to manipulate politeness (polite/impolite) have shown that these cues affect the perceptions of the politeness of the verbal messages. When conveying criticisms, polite nonverbal tone increased perceived politeness and impolite nonverbal tone decreased perceived politeness [16]. Our own prior work has generally tried to minimize non- or extra-verbal cues so that we could study the effects of specific relational variables, but even in this work we have been able to show that contextual variables such as team relationships, power relationships and gender can alter perceptions of politeness as well as compliance behaviors with requests accompanied by those behaviors [17].

However a systematic organization of cross-cultural body behaviors relating to politeness is by and large missing. One attempt to organize displays of nonverbal behaviors in human relations is the use of a "verticality" dimension [18]. The vertical dimension relates to power, dominance, status, hierarchy, and related concepts, and stands in contrast to the "horizontal" (affective or socio-emotional) dimension, which describes the emotional closeness of interpersonal relations and the valence of feelings and behavior [19]. These, obviously, are echoed by Brown and Levinson's P and D dimensions. However, distinctions between dominance power and status need to be taken into consideration. Briefly, dominance includes the motive to control others or the self-perception of oneself as controlling others, while status is a more ascribed or achieved quality implying respect and privilege, but not necessarily the ability to control others. This stands in contrast to power, which is broadly the capacity or right to control others and which may have different function basis (reward power, expert power, coercive power, etc.) [20]. Verticality can be seen as an overall dimension, including different conceptual definitions relating to the same concept, but it may not be concordant with a person across time, relationship or situation (i.e. a leader at work may be meek at home). The dominant-subordinate dimension maps also onto approach and avoidance motives, with associated behavioral tendencies. Interpersonal sensitivity to context should be high for subordinates because of their motive to reduce threat by gathering information [21].

Because nonverbal behavior is often tacit and "off-the-record" it is used to express and maintain verticality without the need to invoke it explicitly. Henley stated whether behavior is associated with power, affecting or resulting from it, as symbols or expressions; as describing, establishing or maintaining power, power and nonverbal behavior are intimately linked [22]. For example, a recent review by Hall et al. [20] links higher verticality with less smiling, more gazing, more lowered brows, more expressive face, more nodding less self touching, more touching others, more hand/arm gestures, more bodily openness, less bodily relaxation, more bodily shifting, smaller interpersonal distances, more vocal variability, louder voice, more interruptions, shorter speech latencies/ less pausing, fewer filled pauses, more laughter, fewer speech errors, faster speech (especially for U.S. perceivers), lower voice, and more relaxed voice (especially

for U.S. perceivers). The authors also found that beliefs about the link between verticality and body behaviors are stronger than the corresponding actual relations. One possible reason for why this is the case is that stereotypes may be activated.

Nonverbal expressions of verticality are also often related to different behaviors displayed by women and men. On average, women show more body behaviors associated with low verticality - they smile more than men [23], are more expressive, touch others more and are generally more sensitive to nonverbal cues [24]. However, it cannot be concluded with certainty that associations between body behaviors and verticality mirror gender differences in nonverbal behavior.

Other models that organize body behavior have been put forth. For example, the interpersonal circumplex theory [25] organizes interpersonal behavior along two dimensions: 1) the affiliation dimension (anchored in agreeableness) and the control dimension (anchored in dominance and submission). It is a model for conceptualizing and organizing interpersonal behavior and motives [26] and can be visualized with a vertical axis (status, dominance, control) and a horizontal axis (friendliness, warmth, affiliation). The vertical and horizontal axes have been associated with the constructs of agency and communion, where each point in the circumplex circle can be specified by a weighted combination of communion and agency [27]. Figure 12A shows a simplified model with submission/dominance and ignore/love at opposite ends along the dimensions of communion and agency. Figure 12B shows the same model where several attitudes are mapped onto this circle, with circles ranging from the center to outer circle indicating intensity. Research in the area of interpersonal circumplex theories provides some predictions about the dominance–submission dimension of human behavior in social interactions. It predicts that people's behaviors will be *similar* to interactional partners along the affiliation dimension and *opposite* along the control dimension, and that when

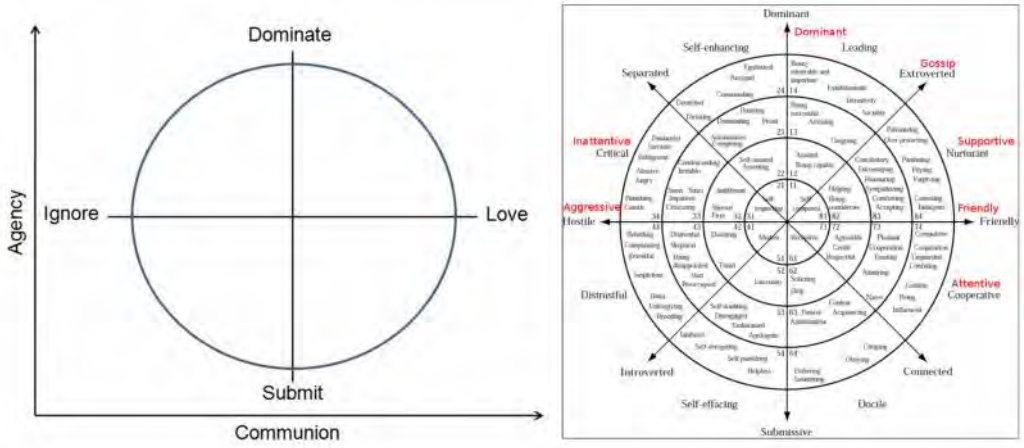


Figure 12 A. Interpersonal circumplex by Isbister, B. Interpersonal circumplex by Leary

this complementary response occurs, the partners will like each other more and will be more comfortable [28].

Cultures have been shown to differ with regard to the value they assign to the vertical dimension of social relations [29; 30]. Thus, cultures can be regarded as a source of diversity in how they value power and who they accord it to. However, data on cultural differences suggests that *nonverbal expressions of dominance* are recognized and processed as transcultural universals, even though evaluations and interpretations of

status and power follow culture-specific values and attitudes. Thus, research suggests a division of power perception into two independent layers - one that is more basic and culturally universal (Dominance: dominant–submissive, weak–strong, respectful–disrespectful and confident– unconfident) and the other, which is more culture-specific (Evaluation: unfriendly–friendly, believable–unbelievable, likable–dislikeable and cold–warm-hearted) [31]. Thus, culture may determine the value attached to a status, but perception of dominance cues (i.e. status cues like expanding body posture) seem to rely on universals, probably grounded in evolutionary theory. For example, in cross-cultural business negotiations, cultural display is able to reveal different expression of status in different groups, while observers agree upon who is dominant and who is submissive [32]. Other studies have found similar results. Cultural universalities have been reported in perception of nonverbal dominance behaviors from facial expressions [33], observation of dominant and submissive postures [34] and from nonverbal status cues, even if those where not part of the own cultural repertoire [32].

In sum, several models of nonverbal behaviors have been proposed following roughly a vertical and horizontal division, with stronger cultural impact along the horizontal dimension. We will return to these frameworks in the next section and propose a way to integrate these with Brown and Levinson's politeness strategies as well as specific nonverbal behaviors that map onto the outlined theoretical model under section 4.

But first, we will report the results of a detailed examination of the literature on three specific types of body behaviors we conducted during this project: gaze, posture and smile. We chose these behaviors in part because there was a rich literature on them, but also to focus our thoughts on how to represent information suitable for integration into our Etiquette Algorithm.

7.1 Gaze - Visual Dominance Ratio

Gaze can transmit essential social information, i.e. about the relationship of two individuals [35] or turn-taking patterns in conversations [36]. It is a powerful modulator of explicit and implicit social interaction [37], signals potential sources of reward or danger and activates approach-avoidance responses [38]. Gaze is also an important nonverbal marker of status. For example, studies of group interactions found differences in visual attention expressed through gaze between high- and low-status group members [39]. The higher the status in the group the more likely it is that people look and follow the gaze of the high status group member. Thus, gaze is a valuable indicator of a person's status in a group. Specifically, status that is based on either competence or dominance attracts more gaze followers [40]. However, in social hierarchical relationships, differences between in- and out-group members have been noted. For example, low-social status male rhesus macaques reflexively follow the gaze of any familiar rhesus macaques, but high-status macaques selectively follow the gaze of other high-status monkeys [41]. Similar findings have been reported among humans. For example, during public speeches, the gaze of politicians has been shown to reflexively capture the gaze of in-group voters [42]. Thus, gaze can also be an informative marker of in-group membership.

A highly effective method to identify status differences is the visual dominance ratio (VDR). The VDR is defined as the proportion that a person looks at another while speaking vs. while listening—as will be explained in more detail below (see). The VDR is used to understand power relationships in face-to-face interactions of two persons [35],

and more recently also in the context of groups [43].

VDR for person A interacting in a dyad with person B is computed as shown in Table 3. In Formula 1 (based on Koch et al., [43]), the numerator is the ratio of A looking at B as a proportion of the total speaking time of A. The denominator is the ratio of A looking at B in relation to the total speaking time of B. If A looks at B for the same proportion in both speaking modes, the VDR has a value of 1. If A looks at B longer while A himself is talking more than listening, the numerator becomes larger than the denominator, and the VDR is greater than 1. In the reverse case, if A looks at B longer when B talks than when A talks, the denominator becomes larger than the numerator, and the VDR is less than 1.

Higher VDR ratios are associated with higher 'verticality' [20] for both men and women and reflective of a person's influence in groups of two people. Persons with relatively little power or status look longer at others while listening than while talking themselves, while more powerful persons look about the same amount of time while listening and talking. In sum, less powerful persons look longer at more powerful persons, especially in the role of the listener.

Table 3. Visual dominance measure for Dyads and Groups

Formula 1: VDR for dyads	$\dfrac{\dfrac{\text{A lwt B}}{\text{A talk total}} \times 100}{\dfrac{\text{A lwl B}}{\text{A listen total}} \times 100}$
Formula 2: VDR for groups	$\dfrac{\dfrac{\text{A lwt total} - \text{A lwt away}}{\text{A talk total}} \times 100}{\dfrac{\text{A lwl total} - \text{A lwl away}}{\text{talk total group without A}} \times 100}$

lwt: looks while talks, lwl: looks while listens, away: looks away, i.e., neither at the entire group nor at a certain target person)

Note that there are echoes of Brown and Levinson's positive and negative politeness strategies in these behaviors, though perhaps not a clear distinction between them. Looking at another (especially when s/he is speaking) is a form of attending (literally, in this case) to the other's face and a subordination of one's own attentional interests. Thus, it is a form of deference and should behave as a redressive behavior. Looking away denies this form of redress and, therefore, asserts power or lack of social connection.

Several research studies have identified the link between VDR and perceived expertise on a topic [44], objectively measured rank [45], ascribed status [46], reward power [47] and personality dominance [46]. For example, when speaking to each other, ROTC officers exhibited ratios of 1.06, while ROTC cadets speaking to officers had ratios of 0.61; undergraduates in an introductory psychology course scored 0.92 when talking to a person they believed to be a high school senior who did not plan to go to college, but 0.59 when talking to a person they believed to be a college chemistry honor student accepted into a prestigious medical school; expert men speaking to women about a subject in their own field scored 0.98, while men talking to expert women about the women's field, 0.61; expert women speaking to non-expert men scored 1.04, non-expert women speaking to expert men scored 0.54 [48].

However, a few considerations need to be mentioned: 1) this behavior occurs primarily at the unconscious level [49;50]. 2) Gaze behaviors in group-contexts help to understand the relative position and influence of single individuals. 3) Sex and situational factors relate to visual power displays. On average, men display more equivalent levels of looking

while speaking and looking while listening, resulting in high visual dominance ratios, associated with higher social power. Women look more while listening than while speaking, a pattern associated with lower power positions [51]. 4) Cultural differences need to be taken into considerations. While some studies found cross-cultural similarities of direct gaze [52], there is also evidence that cultures differ in gaze patterns. For example, research found greater levels of gaze (with regards to appropriateness, i.e. directionality, frequency or intensity) in 'contact' cultures (Arabs, Latin America, Southern Europe) compared to "non-contact" cultures[1] (Asians, Indians-Pakistanis, Northern Europeans) [53, 54]. In some cultures too little gaze is interpreted as a sign of dishonestly and insincerity, while in other cultures turning the eyes downward is viewed as a gesture of respect. In yet other cultures, people use a veil to protect themselves from the "evil eye". However, since the VDR ratio can be understood as a measure of dominance and since verticality/dominance is more likely recognized across cultures, we conclude that the VDR can be indicative for power relationship interpretations independent of cultural context. We will provide an example how the VDR can be calculated an applied to a relevant SSIM sample below in section 9.4.

7.2 Posture – Complementarity and Mimicry

Posture is another important form of nonverbal communication indicative of dominant-submissive perceptions of social relations [55]. Subtle changes in posture can lead to different perceptions of dominance. When people expand themselves and take up a lot of space, i.e. expanding limbs, they are perceived as dominant, whereas when they constrict themselves and take up little space, they are perceived as submissive [56, 57].

Note that there are echoes here too of the Brown and Levinson politeness behaviors. Restricting oneself (in this case, literally), can be seen as a means of reducing or sacrificing one's face to the other's needs or desires. Apologies, honorifics, indirect questioning and hedging, etc. are all negative politeness strategies identified by Brown and Levinson (cf. Figure 2) that are a form of sacrificing or reducing one's face in order to accord more prominence or regard to the face of the other and thus, at least metaphorically, they operate similarly to these physical behaviors.

More erect (less relaxed) posture connotes social potency, but it should be noted that the context determines whether erect posture might be seen as nervous and polite (and therefore reflecting low verticality) or as reflecting proud, confident bearing (and therefore suggestive of high verticality) [20]. These so-called "power moves" [28] communicate the actor's likely status position to observers, because postural expansion occurs more frequently among people who have high status and constriction more frequently among people who are low in status [57]. However, body expansion and constriction not only influences the perception of status, it also influences the behavioral responses of others [20]. Posture and postural responses can help understand D(S,H) and P(H,S) and can therefore influence level of politeness. Changes in postural responses to displayed nonverbal behavior – too – often happen automatically, reflex-like and without intention [58], or even as preconscious and goal-independent behavior.

There are at least two forms of systematic effects of posture displays as a response to the

[1] A contact culture is defined as a culture in which people tend to stand close together and touch frequently when they interact together. A noncontact culture is a culture where groups tend to maintain more space and often less touch than contact cultures.

behaviors of others [28]:

1) *Postural mimicry*: H is a dominant person and S is a submissive person. Let's say H imitates the behaviors which S performs. H displays dominance behaviors as a reaction to S's display of dominance, and H responds to submissive behaviors with mutual submission. Since mimicry is effective at increasing affiliation, it is most likely displayed in contexts where affiliation goals are primary. Mimicry also depends on the status of the actors. People tend to mimic high status people, a pattern referred to as "accommodation" [59]. Mimicry is heightened when people perceive themselves as similar [60], have aligned goals [61], share attitudes, want to empathize [62] or want the actor to have positive perceptions and like them [63]. It is related to factors such as involvement and interest [64] and people who want to be liked and increase affiliation tend to show postural mimicry. When observers see postural mimicry, they are able to not only identify the social distance (affiliation) between two persons but also deduce whether the nature of the social relationship is competitive or cooperative and whether S and H belong to the same in-group [28]. In sum, the goal of postural mimicry is to increase liking, but it is highly context-dependent. For example, postural mimicry is perceived as less comfortable in hierarchical relationships.
2) *Postural complementarity*: H responds with contrasting behaviors to S. Postural complementary happens when a dominant display invites a submissive response and vice versa. Some researchers argue that human postural expansion and constriction is reminiscent of the dominance displays in other species. For example, among primates, such as chimpanzees, dominant group members show body expansion in order to appear as large as possible. Displays of such postures are typically met with submissive displays [65]. Among chimpanzee colonies postural complementary leads to more peaceful relations, while mimicry of dominant displays can mark the beginning of violent conflict. While evolutionary theories argue that similar patters characterize human relations, there is conflicting evidence that this is in fact the case, since humans have not only evolved to more egalitarian relationships, but they are more conscious and strategic about their behaviors in relation to others, making complementarity less common. However, in hierarchical relationships, exhibiting complementary postures across hierarchical levels leads to *more* liking and less conflict.. In fact, nonverbal complementary and the comfort and liking associated with it may encourage and maintain hierarchical relationships. In sum, in hierarchical configurations, postural complementary is considered more comfortable, even though we are largely unaware of the functional aspect of this behavior.

While it is hard to predict whether two individuals will display postural mimicry or complementary, we believe that some theories can either predict and/or recommend adaptive behaviors for any given situation. For example, interpersonal circumplex theory (see Figure 12) predicts that people's behaviors will be similar along the affiliation dimension and complementary along the control dimension. Other studies confirmed this. When S displays an expanded (dominant) or constricted (submissive) posture H tends to complement rather than mimic those postures. But when S and H are relationship partners, they tend to show mimicry [28]. The relationship between social distance and posture is also summarized in Figure 14 in section 7.4.

7.3 Smile

Smile is another form of nonverbal behavior for the cross-cultural understanding of social relationships which may besuitable to be considered for integration in the etiquette algorithm. Among nonhuman primates, all studied species use facial gestures to signal social status in order to help regulate relationships among conspecifics [33]. Among humans smiling has been associated with greeting in both Western and non-Western cultures [57] and is considered a universal expression of happiness [12]. However, there is also evidence for taking a cultural relativistic approach towards the universality of smiling as an expression of happiness. One viewpoint states that expressive displays of emotional feelings are basically comparable across cultures. Another point of view divorces the display of emotions from their biological basis and concedes that display of emotions is influenced by social norms, leading to large variations in smiling behaviors across cultures [67]. However, it is very likely that there are universal similarities in the experience and expression of emotions across cultures, while there are still differences in the appraisal thereof [33]. For example, Matsumoto [68] found cultural differences for display rules for smiling between US Americans and Japanese. While his approach is based on Hofstede's individualism-collectivism and power distance dimension, he found that American participants consider the display of happiness in public as more appropriate than Japanese do. Other researchers compared the perception of nonverbal immediacy behaviors, such as smiling, across participants from Australia, Finland, Puerto Rico and the US and found cultural differenced for the appreciation of touch. However, for smiling or having a relaxed body positions no difference emerged [69]. Yet another study looked at smiling in relation to the social distance between S and H. When comparing smiling at a professor versus a fellow student in different cultural contexts, all students rated themselves as more likely to smile towards the professor than towards a fellow student. But, when asked what intensity seems appropriate, Asian Canadians preferred an intensity of 37.8% vs. European Canadians, who preferred smiles of 87.7% intensity. Thus, while there is evidence for the recognition of smile as an expression of a generally positive feeling, there are a few cultural differences in the display rules for smiling, the frequency of smiling or the perception of smiling individuals. Overall, all members of the groups most often studied - Asians and North Americans - tend to smile frequently and their smiles lead to a more positive evaluation. But there is evidence that members of Asian cultures smile somewhat less and more importantly smile less intensely and this difference may lead to miscommunications of intent in a variety of social situations.

There are also universal gender differences with regards to the frequency of smiles, with women smiling more than men. This tendency is often associated with status, where individuals high in verticality (often men) smile less than women [70; 71]. Interestingly, higher levels of testosterone in men and women have been associated with more self-esteem and (in men) dominant behavior and less smiling [72]. Some researchers have stated women signal submissiveness by smiling more because of learnt and internalized behaviors associated with a want to please. Henley stated that a smile is a woman's "badge of appeasement" [73]. For example, embarrassment and excuses are typically accompanied by a smile [74]. Thus, less powerful individuals need to please, attend to others' desires (often expressed by gaze), need to be sensitive and more polite (often expressed by constrained body movements, taking up less physical space, sitting up straight, etc.) and appease (via smiling). This may also echo verbal expressions of "positive politeness" characterized by Brown and Levinson including exaggerating

approval, intensified interest, in group identity markers, emphasis on approval and agreement, optimism and the use of jokes.

Next we will propose a framework that integrates body behaviors into a model that will facilitate the scoring of these behaviors and enhance the calculations of perceived face threat based on verbal information alone. However, it should be noted that body behaviors are far more complex and nuanced, in particular when cultural norms are taken into consideration. While culture-specific catalogues for body behaviors will be necessary to further develop the model, it is currently out of scope for this effort. Other important nonverbal cues, like prosody, proximity, detailed facial analysis, etc. have been ignored in the preliminary model, which is based on facial expressions (smile, gaze) and body posture alone.

7.4 Relationship between politeness and body behaviors

As outlined in Figure 1, politeness theory identified 5 different strategies with increasing levels of ”redressive value”, used to mitigate or redress face threat. Using the example of delivering a correction, one can label this action as 1) stating the correction baldly on record, with no politeness (“You are wrong.”), 2) displaying positive politeness by indicating solidarity with the hearer (“I can see why you might think that way, but you’re wrong”), 3) displaying negative politeness by respecting the target’s freedom of action and/or minimizing the imposition (“I’m sorry to tell you this, and you’re free to disagree, but I think you’re a little wrong.”), 4) stating the news off the record by using an indirect method (“What about X [another choice]?”) or 5) not conveying the message at all. The use of these strategies will depend on the nature and the context of the interaction, where a speaker will be more polite when a) the relative power of H over S increases, b) the social distance between H and S increases and c) the degree of imposition on H increases. In this example, correction will require more politeness because it is imposing and it will also require more politeness when conveyed to a superior or a stranger.

While a categorization of redress strategies into 5 different ways to linguistically offset face-threatening information is applicable in many cases, and many of the strategies can be communicated both linguistically and non-linguistically (i.e. being deferential or apologetic), some of the linguistic strategies do not have nonlinguistic counterparts (for example using passive voice to impersonalize a request). Thus, while Brown and Levinson’s strategies are almost exclusively designed for linguistic communication, governed by linguistic rules, they do not always generalize to nonlinguistic domains. In sum, Brown and Levinson’s organization of linguistic strategies seems useful, but taking nonlinguistic behaviors/strategies into consideration leads to a different categorization of politeness due to a lack of one-to-one mapping between linguistic and non-linguistic behaviors.

We have already presented models for the organization of nonverbal behavior related to understanding concepts of dominance/affiliation/affect more generally, however a few researchers have put forward suggestions for the organization of nonverbal behaviors within the politeness framework. For one, it seems reasonable to focus on aspects of communication that are part of the immediate conversation (facial display, posture, vocalics, gaze), since these aspects seem related to “facework”. For example, Burgoon and Hale [75] identified 3 primary themes of relational communication: affection-hostility, inclusion-exclusion and dominance- submissiveness. As we will explain below, these themes correspond with nonverbal behaviors associated with the concepts of positive and negative politeness. Nonverbal behaviors associated with relational

communication are likely to impact face concerns. [16]

Brown and Levinson note that positive politeness expresses belonging, approval, liking as well as affection and understanding [76]. Burgoon proposed that relational messages of affection and inclusion relate to communication regarding liking, positive feelings, rapport and affiliation [77]. Thus, communication of affection can be attributed to positive face. In other words, communication of inclusion, belonging and liking addresses positive face for acceptance and approval. Various nonverbal behaviors can be identified as communicating positive politeness, i.e. touching, close proximity, 'smiling', direct body orientation or 'postural mimicry', though such interpretations may (or may not) be culturally dependent. In our example, saying "you are wrong" (a "bald" statement and verbally unredressed and therefore probably rude) might be accompanied by a hugging gesture or through mimicking the body behavior of H (both positive politeness gestures which would reduce the threat by enhancing the positive face of H and, therefore, reducing the D between S and H).

In contrast, negative politeness, relates to the continuum of dominance-submissiveness because dominance is concerned with influence and submissiveness corresponds – at least partly- to an awareness of imposition. Submissiveness operates to reduce face threat by mitigating the asserted or implied P of the S and thus, enhancing the relative P of H over S., while dominance is concerned with displays of influence and power. Negative politeness seeks to reassure H of his/her freedom from imposition through self-effacement and deference [1], which contrasts with dominance goals. Deference or submissiveness can also be communicated nonverbally with smiling or facial pleasantness—though these might be nervousness, hesitation and appeasement (negative politeness) or social enfolding, optimism and humor (positive politeness). In our example from above, using negative politeness the 'correction' message may be expressed with nonverbal displays such as a hesitant approach, tense position, smiling or and postural complementarity. Additionally, there is evidence that the visual dominance ratio is an excellent means to understand dominance and submissiveness behaviors in dyadic communication (and more recently also of group behaviors). See also Table 3.

Other researchers have categorized nonverbal behaviors in response to FTA in a similar manner. For example, Ambady et al. [15] identified affiliative strategies (open, affiliative, joking), circumspect strategies (uncertain, indirect, avoidant, apologetic) and other-oriented strategies (attentive, concerned, agreement seeking, polite, approving). The authors distinguished affiliative strategies, which consist exclusively of positive politeness strategies. Cirmcumspect strategies consist of negative (uncertain, avoidant, apologetic) and off-the-record strategies (indirect). Other-oriented strategies consist of a mix of positive politeness strategies that take the needs of H into consideration (attentive, concerned, agreement seeking, etc.) as well as negative politeness strategies that minimize imposition. Their category of other-oriented strategies consist of a mix of both positive and negative strategies, reflecting newer research suggesting that the delineation of positive and negative strategies may not be clear cut and that individuals tend to use a mixture of both types of strategies [78;76].

Based on the theories outlined above, we propose a framework (illustrated in Figure 13) that focuses on nonverbal expressions of face threat. Just like Brown and Levinson's 5 linguistic politeness strategies can be linked to nonlinguistic expressions indicative of the degree of face threat, body behaviors can be organized along similar levels of expressions, with degrees varying from high to low. When face threat is high, appropriate

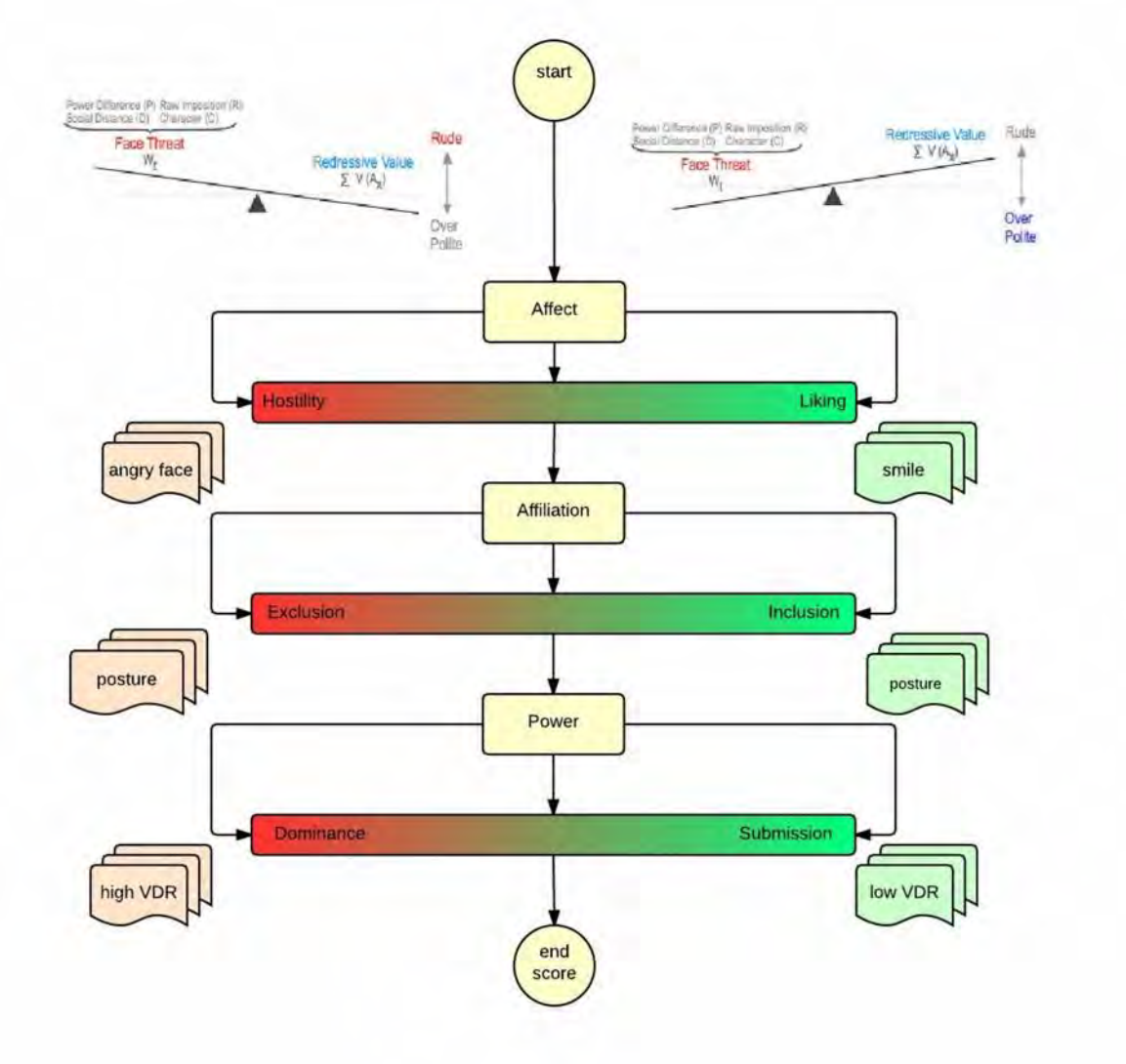


Figure 13. Proposed scoring model for nonverbal behavior.

redressive strategies need to be chosen to counter-balance the threat. This categorization offers a different taxonomy than Brown and Levinson with a somewhat different focus on the utilization context and resulting impact, though it would appear that the exhibited behaviors are the same in both cases.

Using the example of delivering a correction: if I now say "you're wrong", but I do it with a smile, in a submissive posture (i.e. postural complementary to dominant posture) and while looking away, the overall redressive score will be very different than when I convey the exact same message without a smile, in a dominant posture (i.e. postural mimicry in response to dominant posture) and while looking straight at H.

When looking at body posture alone, the information value of a simple dominant or submissive position is pretty clear. However, when looking at postural changes over time as a reaction to the posture of S, then (we argue) social distance needs to be taken into consideration. Based on the literature, postural mimicry would minimize threat if social distance is low (keeping a higher score), while postural complementary poses less threat

in a relationship where D (S,H) is relatively high. If however the opposite were the case, threat would be higher. In our model, if D (S,H) is low and postural mimicry is displayed, it would count towards showing affiliation (which in turn is likely to address face needs) and inclusion. On the other hand, if D (S,H) is low and postural complementary is displayed (i.e. a dominant posture in response to a submissive posture) it can be considered a sign of dissolution, or exclusion (see Figure 14.).

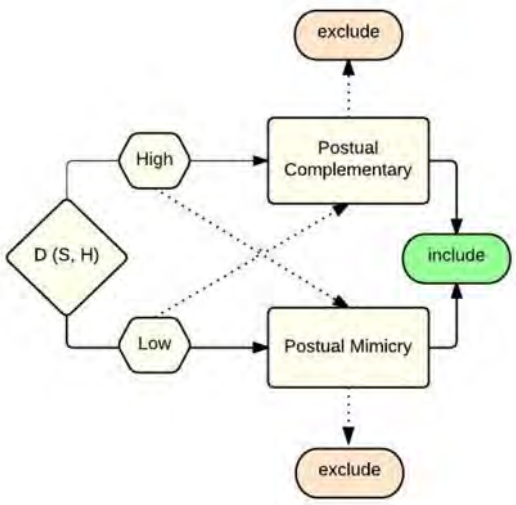


Figure 14. Relationship between social distance and postural complementary/mimicry.

The outlined body behaviors in this section are sample candidates to be integrated in an overall cross-cultural scoring model. The model is far from perfect or complete and should be understood as a preliminary attempt to organize nonverbal behavior.

8. Incorporating Body Behaviors into the EE

8.1 Initial, Simple Case

Body behaviors can be readily incorporated into the Etiquette Algorithm as we previously defined it, although there are some representational and conceptual challenges to doing so. The Brown and Levinson model, while it focuses on linguistic expressions of polite redress, is based on a comparison of face threatening behaviors to behaviors designed or intended to mitigate or redress that threat. Insofar as body behaviors fall into either category (threat or redress), they should be readily covered by the dynamics of the model—and by our computational implementation of it.

Indeed, although our focus in the initial Etiquette Engine development was on linguistic forms of politeness, several simple body behaviors were included in the examples we used in our initial development and testing of the algorithm. For example, in Vignette 1 in section 5.5 (and cf. Table 1 above), the corporal

- is motioned to take a seat, which he does before speaking.
- Takes off his hat before sitting or speaking
- Waits while the mayor continues to write and doesn't speak until he stops, "puts down his pen and looks up at the soldier expectantly"

In Vignette 2 (see Table 2), the corporal:

- interrupts the Mayor while he is speaking
- "perhaps" puts his hand on the Mayor's shoulder
- Speaks loudly

Of these, two were explicitly scored and factored into our overall imbalance computation for these two vignettes (see Table 1 and Table 2). All of these were the corporal's actions, since we were primarily focused on his behaviors. These two were:

- The waiting for an invitation to speak (Vig 1), scored as potent negative politeness at value 60.
- Taking off his hat (Vig 1), scored as an instance of the negative politeness strategy of deference: 50

An additional two or three were mentioned, but not scored: the soldier's sitting in Vignette 1, and his interrupting the Mayor and putting his hand on his shoulder in Vignette 2.

As a simple test case and thought experiment, we will work through enhancing the description and coding/scoring of body behaviors in these two vignettes and then illustrate how they may be incorporated more systematically in the Etiquette Algorithm. This exercise will help us identify techniques, as well as simplifying assumptions. In subsequent sections, we will address these limitations in more depth.

In each of the enhanced vignettes below, body behaviors are underlined. We have expanded the initial vignettes described above to incorporate additional body behaviors and to incorporate them more explicitly.

> Vignette 1A —*High Face Threat, High Redress, Higher Believability*: A low ranking soldier (i.e., a corporal, as indicated by uniform insignia) walks tentatively (initially peering around the open door, then upon noticing the Mayor engaged in work and being noticed by him via a quick glance, takes a step into the room) into the Mayor's office and the Mayor motions him quickly to a seat with a hand gesture. The soldier takes off his hat and sits down, waiting quietly in a constricted manner with his hands in his lap and devoting attention to the Mayor while the Mayor continues to write something. The Mayor finishes up writing, puts down his pen and looks up at the soldier expectantly. The soldier returns the Mayor's gaze briefly but then averts direct eye contact, and then says, "I'm sorry to interrupt your work, Mayor Fredrickson, but my name is Corporal Jones and I've been put in charge of your escort to the event tonight. I was wondering if it would be possible for you to let me know where I can meet your wife so that I can get her there on time?" This last utterance is accompanied by a palm up beat gesture, a smile and an eyebrow-raised questioning/beseeching expression and vocal tone.
>
> Vignette 2A—*High Face Threat, Low Redress, Lower Believability*: As for vignette 1 above except that the soldier acts and speaks differently. Here, he strides into the room without a pause or acknowledgement, coming all the way from the door to behind the Mayor's desk. He interrupts the mayor while he is writing by putting a hand on his shoulder. He puts his other hand on the desk, leaning casually but menacingly over the Mayor as he crosses one ankle over the other in a casual slouch. As the Mayor turns to face him, he makes direct eye contact standing above the seated Mayor, smiling at him he says loudly, "Tell me where I can meet your wife?"

Just to make explicit our interpretations/intuitions about these new versions of the vignettes: by layering on the body behaviors (and calling them out explicitly in the text here[3]), we are emphasizing them to a degree. Our intuitions are that in Vignette 1A, the soldier has been made even more tentative and perhaps obsequious, than he was in the original version 1. Instead of a nominal, normal, unremarkable example of average and expected politeness, Vignette 1A now begins to shade into over-polite—probably not unbelievably so, but moreso than the previous version. By contrast, the soldier in Vignette 2A has become positively menacing. Instead of a humorous misalignment of proper behavior, 2A now strongly encourages (and likely only makes sense under) reinterpretation of relationships between the Mayor and soldier such that the soldier is asserting substantially more power than the Mayor—perhaps because he's a mafia member with some inside dirt on the Mayor or something similar. With those intuitions in mind, we will now try to provide scores to these body behaviors such that they can be incorporated into the equations described in section 5 above. In Tables 4 and 5 we provide revisions to Tables 1. and 2. to include scoring of the body behaviors in the revised Vignettes, along with some rationale for them. Here, non-verbal behaviors are shown in green-shaded rows. Table 4 illustrates the scoring of the added body behaviors we included in Vignette 1A. Since we did not alter the P, D and R relationships from those used in the initial Vignette 1, as described in section 5.5 above, therefore the Wx calculation remains the same and produces a value of 313. The redress value (V(**A**x)) is shown as the summed total in Table 4: 465. This means that the calculated imbalance for this vignette is:

$$B_O{:}I_x = \quad B_O{:}V(\mathbf{A}_x) - B_O{:}W_x$$

$$I_x = 465 - 313 = 152$$

Recall that the Ix value for Vignette 1 (without the added body behaviors) was -18. Since zero represents complete balance, and since there is a fair amount of variance on an utterance by utterance basis, -18 represents a very slight deviation from balance or nominal etiquette and face relationships, while 152 represents a moderate deviation toward "over" politeness. This is very much as predicted by our intuitions as reported above.

Table 5 illustrates the scoring of the added body behaviors in Vignette 2A. Again, the Wx calculation remains the same and produces a value of 313. The redress value (V(**A**x)) is summed in the table: -325. This means that the calculated imbalance for this vignette is:

$$B_O{:}I_x = \quad B_O{:}V(\mathbf{A}_x) - B_O{:}W_x$$

$$I_x = -325 - 313 = -638$$

[3] We suspect that explicit mentioning of a body behavior which would otherwise go without mentioning in text (but would likely be envisioned by the reader) gives added weight or salience to the behavior. For example, the line "'I'll make you pay for that if it's the last thing I do!' said Joe" may well bring to mind the body behaviors made explicit in the alternate line "' 'I'll make you pay for that if it's the last thing I do!' said Joe, his face suffused with blood and spittle flying from his lips." But making them explicit in the text reinforces the image in the mind of the reader and may, therefore, result in still more assessment of anger and threat. The author literally found it important enough to call the reader's attention to these details by explicitly calling them out. This inevitable manipulation of the reader's attention is an intrinsic element of narrative that is not included in free-flowing and non-directed attention management and represents a limitation of using narratives for this type of thought experiment.

Table 4. Redressive actions scored in Vignette 1A.

Action and Interpretation	Score
1. The soldier "walks tentatively into the Mayor's office Anything which startles another and/or which interrupts him/her from a course of action or topic of concentration, can be viewed as an FTA. Therefore, any overt attempt to avoid doing these things counts as an act of negative politeness – especially if it comes at some physical, social or temporal cost to the "Speaker".	40
2. The soldier waits until the mayor is finished and invites him to speak. This seems to be a very explicit form of negative politeness (putting the other's interests first) and, especially in this instance where the H was not actively engaged in another conversation, seems very potent.	60
3. The soldier takes off his hat. This is a sign of deference in our culture, which is in turn a fairly potent negative politeness strategy.	50
4. The soldier sits down, in response to major's hand gesture. This is a somewhat ambiguous cue in context. Sitting minimizing physical space and readiness for physical action and is therefore a negative politeness strategy. On the other hand, it could also be perceived as an invasion of private or controlled space or resources— a threatening behavior in its own right, which should contribute to the FTA (or indicate a degree of informality and presumed familiarity which could be modeled either as a positive politeness behavior or a reduction in D). On the other hand, in this case, it is in response to an invitation/request or order(?) from the Mayor, and therefore indicates compliance and an acknowledgement of power—a negative politeness strategy. In this case, the compliance interpretation to a request seems to triumph, but because it is an acknowledgement of power and compliance with a direct request, it doesn't afford much new power to the Mayor.	20
5. The soldier puts his hands in his lap. Another example of minimizing physical space and readiness for physical action and therefore a negative politeness strategy, but a fairly normal posture in context, so not a particularly large redress action.	30
6. The soldier devotes his attention to the Mayor. This is a fairly explicit example of attending to the needs or "face" of the other and therefore a positive politeness strategy. The fact that he is doing this while the Mayor's attention and behaviors are not focused on him gives it added potency.	30
7. The soldier returns the Mayor's gaze briefly but then averts direct eye contact. This description was intended to indicate a focus of attention, but not so intense or direct as to be challenging. Thus, it is a further example of attending to the needs or "face" of the other and therefore a positive politeness strategy. Now, though (unlike 6 above), the Mayor's attention is focused on him therefore attending to the Mayor is somewhat less redressive	20
8. The soldier apologizes for interrupting. This is also a negative politeness strategy, though arguably a less potent one (though that may be highly mitigated by facial expressions and body language).	30
9. The soldier uses an honorific. Moderately potent negative politeness strategy.	40
10. The soldier poses the FTA as a question. Common negative politeness strategy.	20
11. The soldier offers an explanation/reason for needing the information. Positive politeness strategy, seems particularly powerful in this case.	35
12. The soldier appeals to the Mayor's (H's) interests. Positive politeness strategy Powerful in this context.	30
13. The soldier is hesitant and skeptical about compliance. A common but reasonably potent negative politeness strategy.	30
14. The soldier gives a palm up beat gesture and an eyebrow-raised questioning/beseeching expression and an eyebrow-raised questioning/beseeching expression. This reinforces the hesitancy about compliance expressed verbally in 13 above and represents additional negative politeness.	30
TOTAL	465

Recall that the Ix value for Vignette 2 (without the added body behaviors) was -273. This was deemed reasonable for a vignette designed and expected to produce a large imbalance representing substantial impoliteness. Vignette 2A was expected to produce much more extreme impoliteness and it has, in fact, more than doubled the imbalance score. This is very much as predicted by our intuitions as reported above.

8.2 Issues with the Simple Case

As expected and intended, the thought experiment with using our Etiquette Algorithm to more systematically and extensively incorporate body behaviors, as conducted in the previous subsection, raises many issues. We will identify these issues in this section and propose ways forward where they are apparent.

8.2.1 Body Behaviors as Positive and Inverse Redressors

We achieved the degree of threat shown for Vignette 2A above by treating the soldier's aggressive, threatening body behaviors as a form of *inverse redress.* While Brown and

Table 5. Redressive actions scored in Vignette 2A.

Action and Interpretation	Score
1. The soldier strides into the room without pause or acknowledgement. This is interruptive and therefore explicitly a threat to negative face. Since the soldier offers little or no redress for this act (as he did in vignette 1A), this increases the face threat	-40
2. The solider comes all the way across the room to behind the Mayor's desk. This further enhances the interruption from item 1, but also constitutes an invasion of personal and more private space. Again, there is no redress offered, hence this increases the negative face threat	-50
3. The soldier interrupts the Mayor. This is the inverse of putting the other's interests forward, but is perhaps less extreme a threat than it was a redress in Vignette 1A since the Mayor was not actively engaged with another person.	-40
4. The soldier puts a hand on the Mayor's shoulder. This could (in our culture) be either an extreme positive politeness behavior (indicating strong familiarity and low social distance) or, in the hands of those who do not have that relationship, a strong invasion of personal space and a presumption of familiarity which would cause face threat. Since there is no evidence of such familiarity in the Mayor's mind, this would be interpreted as a strong threat.	-60
5. The soldier puts a hand on the Mayor's desk. Another powerful invasion of personal space and therefore, interruptive and threatening to negative face. Perhaps not quite as potent as physical touching in 4 above	-55
6. The soldier remains standing while the Mayor is sitting. A somewhat mild assertion of power through not minimizing personal stature and posture for physical threat. This could be mitigated or even reversed by context (e.g., the standing servant who is serving food to the seated master) but is not in this context	-20
7. The soldier leans over the Mayor. Another invasion of personal space, as well as an adoption of a posture of physical enlargement and potential for physical action. In addition, this blocks the view of the Hearer, thereby further threatening negative face.	-50
8. The soldier slouches/behaves casually. This is a presumption of familiarity or informality which threatens positive face (though perhaps a culture-specific one). By failing to provide the degree of attention and deference due to the Mayor's position, but soldier threatens his expectation of being valued by others.	-20
9. The soldier makes direct eye contact while standing above the Mayor. Again, perhaps a culture-specific threat and dominance display. Starring down another can be a dominance of attention and, therefore, a negative face threat.	-30
10. The soldier is very brief and therefore, takes little of the mayor's time. This could be counted as a negative politeness strategy of directness (albeit not a very effective or unambiguous one).	30
11. This could perhaps also be counted as an example of the positive politeness strategy of optimism and assumed compliance—though again, not unambiguously.	10
TOTAL	-325

Levinson talk about verbal "politeness" behaviors primarily in the context of their use to redress face threats, it seems quite apparent that other behaviors (whether verbal or non-verbal) can contribute to a perception of threat rather than ameliorating or offsetting it.

Thus we used the technique of simply inverting the sign and treating threatening "redress" behaviors as contributing negatively to the V(**A**x) term in the equation. This has the effect of increasing, rather than decreasing, the negative imbalance (Ix) in the vignette.

While this use of "impolite" behaviors to increase the Face Threat in an interaction is not explicitly discussed in Brown and Levinson, it seems to be a natural extension. After all, verbal and non-verbal human behaviors are not only used to redress inherent face threat. Instead, we have at least as rich a repertoire of threatening, insulting, power asserting and dominating behaviors as we do redressive ones.

Furthermore, this approach was used (albeit not in the examples shown in section 5 above) in our prior work with verbal behaviors alone where, for example, failing to respond to a greeting with a subsequent greeting was modeled as an insult rather than a neutral activity.

Admittedly, the notion of "inverse redress" invites some linguistic confusion when used in conjunction with Brown and Levinson's (and, indeed, much of cultural

anthropology's) use of the terms "negative face" and "negative politeness". Negative Face is the desire to have one's will hold sway; to not be thwarted. By contrast, Positive Face is the desire to be accepted and valued as a part of a group [1, p. 62].

Both are "Face Needs" and threats to either can constitute a Face Threat that needs to be redressed in Brown and Levinson's model. Negative Politeness, then, in Brown and Levinson's usage, appeals to and more potently redresses the Hearer's Negative Face and involves strategies such as minimizing and explicitly apologizing for the hindrance, distancing the speaker from the imposition and/or explicitly acknowledging a debt from it. It has the effect, generally, of acknowledging or enhancing the Speaker's Power Distance from the Hearer. By contrast, Positive Politeness appeals to the Hearer's Positive Face by strategies which seek to reduce social distance and enhance the Hearer's status as a member of a group with the Speaker.

Thus, both positive and negative politeness behaviors have "positive" redressive value—they reduce face threats, albeit in different ways. In contrast to both of these, the *Inverse Redressive* acts we have introduced do the opposite—they increase face threat. Indeed, it is quite probable that there are different classes of inverse redressive acts that achieve their threatening properties by offending the Hearer's positive vs. negative face, though we have not considered this to date.

Unfortunately, the use of "negative face" and "negative politeness" substantially predate this work and we have done the best we can by terming these behaviors "inverse" rather than "negative" redressive acts.

Approach: *Model redressive actions as capable of either redressing face threat ("redress") or of exacerbating it ("inverse redress").*

8.2.2 Relationship Between Inverse Redress and P, D, R and C

While the above strategy of modeling "inverse redressive acts" seems to work well for modeling body behaviors (and verbal behaviors) which threaten instead of redressing, it works best "in the moment" during a single interaction. There is a more complex relationship between the balance and kind of face threat that is allowed to stand in an interaction and the evolving perception of Power Distance (P), Social Distance (D), Imposition (R), and Character (C) terms which we have only sketched to date.

As we mentioned in section 5.5 regarding Vignette 2A, extreme or sustained imbalance scores invite all involved (Observers, Speakers and Hearers) to rethink their a priori assumptions about P, D, R and C terms. In Vignette 2A, we see that the initial notion of the relative power of a corporal and a mayor contrasts extremely with the perceived imbalance in the corporal's verbal and body behaviors. Together, these invite the Observer/Reader to reinterpret their roles, seeking some way to make sense of the corporal's behaviors. Perhaps, for example, he is secretly a mafia member with a hold over the Mayor?

More subtle examples occur everyday in our lives. Not every utterance has to be balanced, but taken over time and interactions, we establish a P, D, R and C for those we interact with. If that balance is not maintained, then one or more of those dimensions for assessing face threat (and resulting redress behaviors) will shift. We modeled an example of this sustained (though only over a roughly 10 minute period) interaction in a mild altercation between U.S. and Russian astronauts on board the International Space Station in [5].

As a heuristic for practical use of the Etiquette Algorithm, we have generally regarded the P, D and C terms of the Wx equation as fixed within the duration of a given conversation. Imposition (R) is a function of the topics discussed and/or requests made and therefore can shift with changes in topic, but is largely fixed within a time scale for that topic. By contrast, redress and inverse redress behaviors can have the effects of contributing to the perceived imbalance and, therefore, the perceived threat on an interaction by interaction or even utterance by utterance basis. There is, clearly, a link from the "local" perception of threat in an utterance, and the "global" perception of P, D, R and C, but we have not yet begun to map this relationship or its dynamics.

Approach: *Develop and flesh out the theory of the link between redress and perceptions of P, D, R and C. Detailed research into this representation is beyond the scope of this work, but we do propose a theoretical model in section 7.*

8.2.3 Temporal Unit or Time Frame for Body Behaviors

Another challenge for incorporating body behaviors in the etiquette framework we previously developed for verbal interactions is knowing what the temporal unit of analysis and representation should be. Whereas verbal interactions have a natural start and end point, and are naturally interleaved—with one party generally talking while the other listens—none of that is necessarily true of body behaviors which, after all, may occur over sustained intervals (e.g., a persistent frown or scowl), may occur concurrently with the activities of the "Speaker" (e.g., a scowl triggered by and mostly concurrent with what the Speaker is saying) and/or may involve subtle second by second (or even less) changes which can be interpreted for meaning.

What kinds of time frames should we model/use? How should we accrue redressive value "points" (whether normal redress or inverse redress) over time for sustained behaviors? How should we model rapidly changing behaviors—especially in circumstances where an Observer might interpret them not as successive and different redress maneuvers, but as an initial perception that was corrected "mid-flight", roughly the body behavior equivalent of a verbal "stumble" rapidly corrected?

One approach would be simply to monitor for variation. Thus, when a scowl first initiates, it incurs its requisite inverse redress value in the initial interval in which it occurs. When a new behavior is exhibited, at whatever perceptible rate it changes, the changes should be modeled as new events with new redressive impacts.

But this in no way accounts for sustained body behaviors. Should a behavior which persists over many minutes or hours never have an impact on face threat and redress after its initial observation? This seems in error. An alternate approach would be to sustains the value of the behavior for all future intervals[4] in which it is present and unchanged

[4] This does not entirely solve the problem of what to count as an interval, of course. In our prior work, there was no consideration of intervals in which there was no speech—thus, in principle, it was impossible to give or redress face threat without speaking. This was an acknowledged simplification. Here, we would suggest that all intervals in which the body behavior of one individual is perceptible by another, threat and redress from those behaviors should be mapped and scored. Any convenient interval could be used for mapping but it would seem that most of our intuitive scoring is centered around the time period of utterances and conversational exchanges, so perhaps a typical interval tied to typical utterance lengths might be appropriate—say, a few seconds.

But a simple thought experiment suggests that this still leads to fairly coarse and inaccurate results. Consider, for example, two individuals in a room. One suddenly begins to exhibit threatening body behaviors (a scowl and an enlargement of posture coupled with direct eye gaze) toward the other. Clearly, these behaviors should incur some inverse redress when they first occur (and are detected by an Observer). If they are sustained over minutes or hours, however, the threat is not simply sustained. Rather, our sense is that it initially grows, but then (again, *if unchanged*) begins to attenuate and at some point (perhaps with a nervous laugh), the observer will eventually come to regard it as an aspect of the individual's Character (C) and new baseline expectations are formed around it. At an intuitive guess (which could, perhaps, be validated by research), the initially perceived value rises for approximately two minutes to roughly twice its initial value and falls for slightly longer, roughly as in a chi squared distribution, as illustrated in Figure 15.

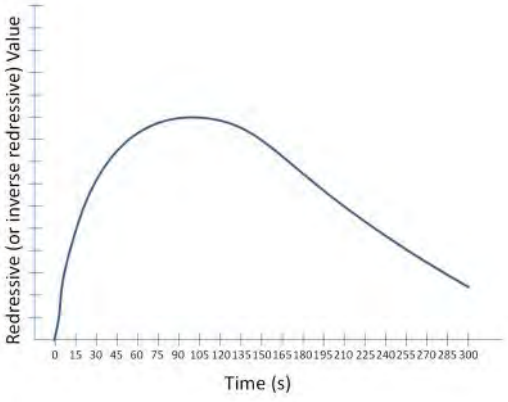


Figure 15. Hypothesized temporal effect of a novel body behavior on redressive value.

Approach:

- *Model the temporal unit of body behaviors around perceived changes in such behaviors.*
- *Model the effects of a sustained body behavior at ~15s intervals over period of ~5 min as—or acquire better empirically documented distributions of sustained body behavior effects.*
- *Body behaviors sustained over repeated longer intervals than a few minutes will be incorporated into revisions to perceived P, D, R and C as discussed in 8.2.2.*

8.2.4 Concurrent Body Behaviors

Threat (and perhaps redress) can be incurred even during intervals where person is not speaking. This is something that was not represented in our earlier work since redress and threat were explicitly tied to verbal acts and it was assumed that either two people could not be speaking concurrently or, at least, that if they were they would not be attending to the other.

This does not seem to present a significant problem and is, in fact, already addressed via the recommendations in 8.2.3 above: simply model the impacts of body behaviors either as they change or at a intervals of a few seconds if they are sustained. This should hold for an observer regardless of whether the observed person is speaking, or listening, or doing neither.

In principle, this means that separate "streams" of threat and redressive value may need to be modeled on an ongoing basis for all participants.

Approach: *Model the body behaviors as they occur regardless of whether the actor exhibiting them is speaking, listening or neither.*

8.2.5 Sequential Dependencies

Some body behaviors have their significance partly or wholly in the context of behaviors that have gone before. For example, physical mirroring behaviors (duplicating the behaviors of another) can be indicative of bonding and social cohesion [28], and therefore, likely, of reduced Social Distance in our terms. But the significance of, say, crossed arms then becomes dependent on whether or not the individual's interlocutor previously and recently crossed his/her arms.

While the prominence of such sequential dependencies may be greater with body behaviors than they are for utterances, these relationships are not entirely absent in spoken interactions. For example, the failure to issue a greeting in an interaction takes on more weight (more inverse redress) if the failure happens after the interlocutor has issued one than if neither person has done so. This sort of tracking demands that a historic queue of such behaviors be kept and referenced when assigning values to each new utterance. While this is a bit more demanding of any implementation, it is well within feasibility.

As to what should be the appropriate size or depth of that queue, we are not sure, but the duration of the conversation seems to be a reasonable heuristic.

Approach: *Maintain a history queue of prior body behaviors of approximately the duration of the conversation or interaction and interpret the threat or redress value of actions in light of prior actions in that queue.*

8.2.6 Other, More Intrinsic or Sustained Aspects of Body Behavior

Another issue to be dealt with in this approach is representing and handling the effects of "intrinsic" body behaviors—that is, aspects of bodies and the behavior perceived from bodies that is neither intentional nor transitory. For example, body attributes such as size, musculature, age, physical agility (vs. obvious disability) and particularly, gender. These attributes clearly affect perceived threat and, perhaps, perceived redress as well. A large, young, agile, heavily muscled man who is standing passively in a room is nevertheless more "threatening" (probably both physically and to one's face) than an elderly, disabled, petite woman—and would likely tend to be treated with more "politeness" (i.e., redressive behaviors) in most cultures, unless other knowledge were brought to bear. Such phenomena might be regarded as bodily attributes rather than behaviors, per se, but they nevertheless influence interpretations of, especially, power but also potentially of familiarity and imposition.

Note that other, somewhat more transitory attributes may also be treated in a similar fashion—such as clothing, insignia, tattoos, etc.

Again, we note that such attributes are not without their analog in spoken behavior where the pitch, volume, accent and even choice of language to use and specific word choices can also signify intrinsic power or weakness—as well as dimensions related to at least familiarity such as tribal, clan, group, class or even professional affiliations (through jargon usage).

A partial solution to this issue comes through the realization that these are all cues not so much to the face threat or redress present in the immediate act as in the perceived

"baseline" P, D, R and C attributes of the interactant him- or herself. Note that in the example provided in sections 5 and 8.1 above, we *began* with an assessment of the P and D attributes of the interactants (i.e., the corporal's power relative to the mayor) as well as of the "raw" imposition of the act. The redress (or inverse redress) present in the more transitory verbal interaction behaviors was then compared to the face threat imposed by those more stable assessed values. We even noted (cf. the example story vignette in 5.5) that the rank of the corporal would be as indicated by his uniform insignia. All this means that less transitory bodily "attributes" may be treated as elements of the scene which enable a person or character to infer the P and D (and perhaps R and C) attributes. They should not be treated as weights or mitigating factors on the redress or inverse redress value of the (more transitory) behaviors exhibited in the interaction.

Of course, there are two potential problems with this approach. First, the difference between a transitory and a non-transitory attribute is fuzzy at best. Attributes such as accents, though themselves probably not usually transitory, cannot be observed until a transitory utterance is provided. Similarly, if the corporal puts on his uniform (and thus the insignia becomes visible) during the course of an interaction, the impact will likely produce an adjustment in perceived P value and therefore, perhaps, in the perceived politeness value of the entire interaction to date. While this may be a problem for computational implementation, it seems to accord with human perception and implies that an ongoing, revisable assessment of P and (and probably R and C) needs to be a feature of any sophisticated implementation.

And that is the second problem—again (as in 8.2.2 above) we need a data driven and well-fleshed out model of how observations of transitory attributes and behaviors enters into a more stable model of durable attributes of an individual. This is well beyond the scope of this effort and gets close to a general theory of personality and social interaction, if not of overall perception and cognition.

Approach: *Treat non- (or less) transitory body behaviors and attributes as perceptual cues to assess Power and Social Distance (and perhaps Imposition and Character)—thereby factoring their influence into the assessed W_x side of the equation--rather than as factors influencing or altering the redress (or inverse redress) side of the equation—and thereby the assessed $V(\mathbf{A}_x)$ side.*

8.2.7 Cultural Differences in Body Behaviors and Their Etiquette Implications

A core issue, but one that we resolved in prior EE work, is that redressive behaviors differ from culture to culture—both in their core meanings and in their relative weight. Classic and obvious examples of this are hand gestures—the circled thumb and forefinger that signify "OK" in America, signify (according to unverified web sites) that the person it is directed at is a "zero" in France, an asshole in Brazil and Germany, and is insulting to homosexuals in Turkey. More subtle examples the relative weight and significance of eye contact, proximity, various forms of casual touching, etc.

The situation of cultural differences in behaviors and interpretations is certainly not limited to body behaviors. In fact, the linguistic variations in how to say, for example, "I'm sorry" (vs. "Lo siento" vs. "Je suis désolé") are so extreme that we don't call them "cultural variations" but rather "different languages" and we assume that one is essentially incomprehensible unless one "speaks the language".

We had developed techniques to manage this kind of distinction within our prior work on the EE. We used separate knowledge bases storing the culturally recognized and valued

threat and redress behaviors for an individual culture. We also had the capability to differentially weight the importance or perceived worth of the different terms of the etiquette equation (cf. section 6) to represent more systematic differences between cultures (where, for example, culture A weighted social distance more prominently than power difference, while culture B did the opposite). Using these methods we were able to represent, for example, the difference between an American officer's intent to show deference by removing his hat (a behavior with redressive value in American culture) but instead to give offense by leaving his sunglasses on (a behavior with inverse redressive behavior in a Pashtun context, but with no particular value or significance in American culture) [4].

Since we have already demonstrated this capability for both verbal and some (very limited) body behaviors, and since we expect cultural variations in body behaviors to be somewhat less than in grammatical speech, we do not anticipate a problem with this issue. On the other hand, the issue of how to create these knowledge bases, and how to capture cultural similarities and differences in them, remains a large problem and will be discussed in 8.2.9 below.

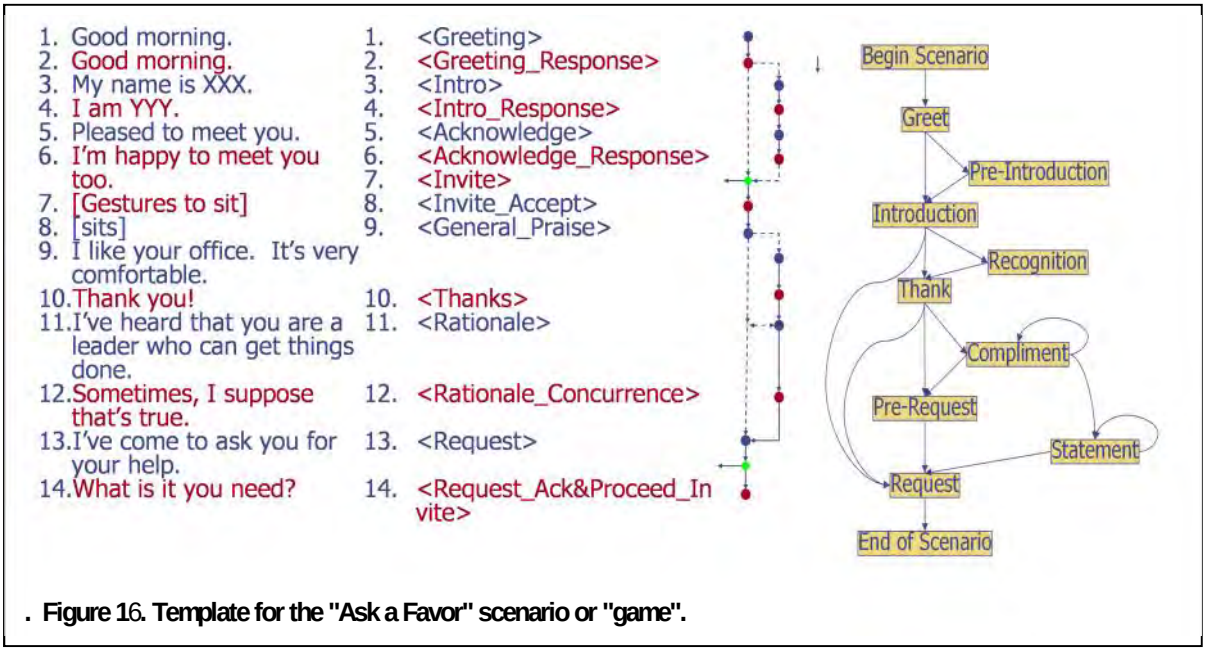
Approach: *Employ different knowledge bases to contain different cultural (or even individual) behaviors and their associated redressive or inverse redressive values.*

8.2.8 Modeling Considerations

Even in the simple example above it is possible to see instances of behaviors (both verbal and non-verbal) whose threat or redress value is context or sequence dependent. In Vignette 1A, for example, the soldier sits in response to a request/invitation from the mayor—an act indicating compliance and deference rather than invasion and presumption (as it would have implied if done without such an invitation). Similarly, in vignette 2A, the soldier invades the mayor's personal space repeatedly without an acknowledgement or invitation—without a greeting or permission. Since this is the first time they've encountered each other (at least in recent time in the context of the vignette), this lack of greeting and acknowledgement is additionally rude.

Our approach to handling these contextual and/or sequential dependencies is to incorporate a context-specific model of the series of actions expected and permissible within the an expected interaction context. This seems to be similar to the notion of social "games" developed by Michael Mateas and others at UC Santa Cruz's (UCSC) Center for Games and Playable Media as a part of their IMMERSE project. In fact, we have sometimes referred to these schemas as "games" and the individual steps within them as "moves" in the appropriate game. Figure 16 (an extension of Figure **6** above) illustrates one such template we developed for an interaction involving asking for a favor under prior research with the etiquette algorithm.

Using templates such as this has the advantage that it permits a reasonable degree of context and sequence to be captured and represented in the creation of context- or, literally, template-dependent values for each behavior in the template. For example, the issuing of a generic, or specific, greeting type can be given a value for its occurrence at the beginning of this sequence that might be different if the same phrase or behavior occurred in another template. We used this kind of sequentiality, for example, to capture the fact that a greeting given as a "Greeting_Response" in this template (that is, in response to a "Greeting" action) was less redressive than the same phrase issued in the initial position—as the Greeting action. In other words, my responding to you with a



. Figure 16. Template for the "Ask a Favor" scenario or "game".

greeting that is just as warm or polite as yours was to me is *less* redressive than your initial greeting was. On the other hand, the failure to provide a Greeting_Response after a Greeting has been issued could be modeled as having a strong inverse redress (or threat) effect.

On the other hand, such templates worked well in the context of a semi-scripted game or interactive scenario where we could exert control over the steps the user/trainee took and guide or steer them in accordance with the storyline. A few, well-crafted misunderstanding actions could be used to cover many instances of the trainee's "getting off the track". It is currently unclear to us how far this template-based approach can be extended to cover a completely unrestricted range of conversational and interaction options. We are hopeful that the "social game" representations we understand are being developed for SSIM by UCSC will be more powerful than the simple ones we have used previously. One potential approach to less restricted interactions would be to incorporate a nuanced plan recognition and planning module.

Approach: *Employ game-like templates to structure interaction moves and associate redress and threat values or value modifiers with actions (verbal or non-verbal) with the position in the template where the action is observed.*

8.2.9 Where do we get those values?

Easily the most significant practical question is posed in the title of this subsection. The etiquette and politeness-based representation and reasoning approach we are advocating here requires that substantial knowledge be represented in order to arrive at an expectation or decision about the politeness "balance" between redressive behaviors and face threat (itself based on power, social distance and imposition perceptions) that a particular individual or simulated character has. When that character changes, perhaps to represent a different individual or one with different cultural biases, or when the context changes, new knowledge is required. Where does that knowledge come from?

In section 6.2 above, we describe many approaches to reusing cultural knowledge once captured in a format appropriate for using our approach. Figure provides some evidence

of the scale up potential of using our approach. While each of these shows that there is an advantage to structuring knowledge in the format required for this approach, neither fully articulates where that knowledge comes from, much less how it will differ when we seek knowledge about how to interpret and value body behaviors.

Brown and Levinson provided a taxonomy for abstract categories of linguistic redressive behaviors that, they claim with supporting evidence, are culturally universal (cf. Figure 2). We have used that taxonomy extensively in our work to date with linguistic forms of politeness. This has helped immeasurably in recognizing and scoring redressive behaviors in multiple scenarios and, especially, cross culturally. We have also proposed using it as a prime component in a more systematic and serious knowledge acquisition and representation effort in support of politeness reasoning in an extended simulation.

But is there an equivalent taxonomy for body behaviors? Not that we know of. Brown and Levinson provide some guidance—anything that incurs costs and sacrifices one's own face can serve as a redressive behavior to others. Anything that appeals to positive face is a positive redress strategy and plays more to group membership and reduced Social Distance. Anything that appeals to negative face is a negative redress strategy and plays more to power and maybe reduction of imposition and thus enhances H's P and reduces R. These general principles can serve as a guide for recognizing and scoring body behaviors.

Furthermore, specific behavior types in Brown and Levinson's taxonomy frequently have their analogs in body behaviors. For example, Figure 2 includes negative politeness strategies such as:

- Question, hedge—which has a body analog in tentative posture and gesture or movement into a forum, or even the more explicit shoulder shrug.
- Be pessimistic—which has many analogs in facial expressions
- Minimize imposition—which has physical analogs in the diminution of physical presence through hunching, bowing, lowering one's head, etc.

Beyond this, we have begun work toward a general framework in section 7, but are far from finished. That was never a realistic goal for this project and, indeed, there are hundreds of researchers working on aspects of it across many fields (and several who worked toward it in SSIM).

In the meantime, appropriate knowledge bases for SSIM will have to be constructed via expert interviews and tested for their cross-cultural validity, perhaps with guidance from the structures Brown and Levinson provide and/or that other researchers have identified and suggested—much as we have worked toward in section 7.

Approach: *Employ traditional SME interview techniques while seeking generalizable frameworks for types of body behavior from the literature as we have done. The reusability of the politeness framework should help to amortize knowledge acquisition and representation costs and facilitate more rapid scale up.*

9. A Worked Example

9.1 Background Scenario and Assumptions

We sought one or a few specific examples of cross cultural interactions with rich body behavior content to apply the ideas outlined in the rest of this document to as a walkthrough test case similar to those we reported in sections 5.5 and 8.1. After consideration of various alternatives, and with some belief that using materials familiar to the rest of the SSIM project would be valuable, we settled on some of the Georgetown videos of role-playing military training scenarios wherein soldiers interacted with role playing (but culturally "native") translators and village elders. Thus, while staged events for training purposes, these scenarios were intended to be very representative of actual military cross cultural interactions and *were*, in fact, instances of high fidelity training exercises that soldiers go through to prepare for such interactions.

We chose to begin with an analysis of "Video 1 Bud and Mark Introductions.mov" an interaction in which two soldiers and a translator interact with two village elders. The video is 21 seconds long and involves simple greetings and introductions but, as will be seen below, contains some 38 recognizable body behaviors. A still from the video is shown in Figure 17.

Figure 17. A still from "Video 1 Bud and Mark Introductions.mov" showing all primary interactants.

There are at least 9 different individuals visible in this video, in what appears to be 3 distinct groups:

1. two men in tribal (?) garb sitting in the foreground on chairs with a small table and hookah between them. One, (on viewer's left), is wearing a white robe and may be hatless and bald with a fringe of what may be gray hair, may be older. We will call him "WR" for White Robe. The other is wearing a tan or gray robe (the video is B&W) and a cap or small turban. He appears somewhat younger. We will call him "GR" for Gray Robe. Actually, we are told that there is a third man present at this small table but he is silent and not visible in the video due to the angle from which it was shot.

2. Three men in military attire seated on a carpet on the floor. The two on the left and right have identical uniforms, while the center one is somewhat different (including a hat). The soldier on the viewer's left ("LS") seems slightly larger than the one on the right ("RS") but it is otherwise unclear who is senior in rank or age. Both appear blond. Both appear ethnically unlike the two seated men in

group 1 and the third soldier in the center ("CS"), who is smaller and may be of the same ethnic group (at least broadly speaking) as GR and WR.

3. The third group of 4 men is in the back of the room relative to the viewer/filmer. These men are sitting on tables or, in one case, kneeling on the floor. They are dressed largely in western style with pants and long sleeved T-shirts/sweatshirts/sweaters. One is wearing what may be a baseball cap. They appear to be observers of the main "action" in the foreground-- whether affiliated with either group or the observers/raters of this training exercise is unclear-- and will not be considered further.

In general, the quality and viewpoint of the video is such that detailed facial expressions are impossible to detect. Therefore, these will not be considered in the example below. Similarly, the audio quality on the video is somewhat poor, and we did not have access to the translation of those non-English utterances which can be detected. For those reasons and the fact that our emphasis was on reasoning about body behaviors, we have used those verbal behaviors we can detect as temporal “milestones” in the scenario, but have otherwise not systematically scored the politeness value of the verbal behaviors in the scenario. Doing so, would be exactly parallel to the examples provided from our earlier work and reported above.

One implication of not including these verbal behaviors in our scoring of this scenario is that we are *underrepresenting* the number (and therefore, the combined redressive potency) of the redressive behaviors in the scenario. For those reasons, we might expect the scoring in the example presented below to produce a result indicating moderately undressed face threat--suggestive of moderate rudeness—on the assumption that if we also factored in the impact of verbal behaviors, face threat and redress would be more nearly balanced. On the other hand, the same could be said of our past efforts—that our almost exclusive focus on verbal politeness behaviors should have represented an underrepresenting of the total amount of redress available in the actors’ behaviors since we were not separately scoring their body behaviors. The fact that we nevertheless got reasonable values from scoring only verbal politeness behaviors suggests that we may have been *over* counting the redressive value of verbal behaviors alone.

9.2 Assessing a Scenario

9.2.1 Identifying the Observer and His/Her Knowledge

An important initial consideration in scoring the body behaviors in the video scenario is identifying the “observer”. Our etiquette-based approach is inherently situated as the perceptions and cognition of a specific observer with a specific set of knowledge and assumptions about the scene observed and the participants in it. If the observer changes, then the knowledge and valuation of the phenomena observed may also change and therefore, the perceived politeness balance may also change.

While we could potentially construct different valuations for each participant in the video, or for any variety of outside observers with varying a priori knowledge of the scenario, participants and their attributes and behaviors, in practice, we only had reasonable access and insight into one set of observers: ourselves. Since we had insight into our own knowledge and a priori assumptions about the scenario, treating ourselves as the modeled observers made a good deal of sense.

In an implemented system, the knowledge we brought to bear would be included in a culture- or even individual-specific knowledge base. Alternate knowledge bases would contain differing "rules" and/or values and could be "swapped" to represent the perceptions of different individuals. This capability was illustrated in our prior work on the etiquette engine [4].

For us as observers of the current video scenario, this would include knowledge (or, perhaps, "assumptions/biases") such as the following, albeit formalized:

- Individuals positioned higher in a room or setting, or at the head or center of tables generally have higher power
- People who lead the action (e.g., speaking first) are generally "leaders"—higher power
- Specific types of clothing are indicative of cultural and organizational affiliation; similar clothing indicates similar affiliation and thus, reduced social distance
- Greetings should be acknowledged and responded to; failure to acknowledge a greeting is strongly rude
- Palms pressed together combined with a head bow is a polite, if somewhat formal, greeting gesture in some cultures—and the depth of the head bow is indicative of the degree of warmth/sincerity and perhaps of power acknowledgement intended in the greeting
- The body position of all 5 men is roughly similar – none of them displays neither highly constricted nor highly expanded body postures – affiliation seems to be the goal. LS maybe displays most constrictions, while WR most expansion. WR also looks while listening.
- Two soldiers keep touching their heads almost synchronous - mirroring can be interpreted as in-group marker.

In fact, all of the phenomena listed and all of the values associated with them in the subsequent sections are based on our perceptions as the observer of this event.

We should note that these perceptions were augmented by some information reported by a representative of the Georgetown individuals who observed and filmed the initial interactions (Aubrey Logan-Terry). This information included (based on the textual descriptions she provided to us):

- The individuals in the back of the scene are trainers and researchers and were not considered part of the scenario.
- There were three individuals playing the role of "village elders" seated in the front of the scene. They are meeting in the village of Sepkati.
- These village elders were, in the context of the broader scenario of which the film clip is a small portion, each from a different village and they are having a meeting among themselves to discuss issues in their villages (stolen property, bombings, etc. due to terrorist activity in the area).
- The training cadre arrange the scenario such that a team of Soldiers often arrive at Sepkati (the village where this meeting is taking place) without knowing that

the village elders are already meeting. This is meant to emulate the "real world" nature of arriving at a village with little intelligence and trying to figure out what is going on while being respectful and not upsetting the villagers.

- The soldiers in this particular video were flagged as particularly good examples because they entered and sat on the floor in front of the three village elders.
- This is likely the first visit of these soldiers to this village, hence there is no familiarity between the soldiers and the villagers
- The elders know one another but there is some tension. Ali, the “loudest” village elder, is noted for his "high involvement" from an interactional style perspective--often engaging in speech overlap, topic change, etc. He, is the elder for Sepkati and thus the host of the meeting.
- The other elders may suspect him of being involved with the terrorists and enabling their activities in the region--the Soldiers don't know this at this point in their meeting/conversation. , There are hints about tensions among the villages that the training cadre have planted at various other sites, so the soldiers may suspect something, but their main goal is to just get in and meet these elders and gather whatever information they can about the terrorist activities in the area while working to build a positive relationship.
- Most of the soldier teams roll into the villages in their Humvees expecting a possible kinetic experience, they don't often realize that they are interrupting a meeting among village elders. The village elders are not expecting the Soldiers to arrive. Often the Soldiers are brought to the village elder's house by the local police chief and, depending on how respectfully they enter, the village elders may be offended that the Soldiers are there. Again, this team was flagged as a "good stranger" example.
- This encounter is potentially very face threatening on many fronts. The village elders are wary of Americans who have come to their villages in the past and not helped much with the terrorism problem. As mentioned above, the Soldiers are (inadvertently) interrupting an in progress meeting among the village elders, so they offer more imposition on the village elders, though they may not know this. Those who attempted to mitigate this by explicitly apologizing, offering reasons for their visit, using a "help frame" are most successful.
- There is also the factor that the Soldiers are carrying weaponry. Some Soldiers did their best to have other Soldiers "run security" so that they could focus on the interaction with minimal need to have weapons featured visibly as weapons can serve as an inherent source of interactional trouble.
- The interpreters in these scenarios tended to be as "neutral" as possible--they were not meant to be from local or rival tribes in hopes that they wouldn't serve as a complicating factor in the Sodliers' information gathering and relationship building attempts.
- The Soldiers are taught by their interpreters to use the locally appropriate "Namaste" gesture (palms pressed together in front of chest, bowing body) upon entering and leaving social encounters. Some Soldiers did, some didn't.
- The hand-to-heart gesture that Mark, in particular, uses is more of an idiosyncratic gesture that is just part of his interactional style. The role players mentioned during their stimulated recall interviews with us that Mark was "likeable" and one of them even mentioned how he seemed sincere with his hand gestures, etc

9.2.2 Assigning P,D,R and C values

In order to assign values for Power (P), Social Distance (D), Imposition (R) and Character (C) for each of the primary participants in the scenario, we began with the a priori knowledge we possessed about those involved and their relationships and intent.

Initial viewing, before being given the Georgetown knowledge described above, suggested intuitively that there were 2 primary groups—the three soldiers and the two villagers--with perhaps some subdivisions within each of them. The physical divisions and groupings in the scene, along with the clothing, make these groupings fairly obvious.

There seem to be within and between group affiliations and power differences which we will characterize first:

- Groups wearing similar styles of clothing, and, perhaps, being of similar ethnic groups are likely to have less social distance than those wearing different clothing styles or from different ethnic groups, since each of these serves as a marker of group affiliation or identity. This implies that the D value between LS, CS and RS should be smaller than the D between any of them and WR and GR. Similarly, the D value between GR and WR should be smaller than that between either of them and any of the soldier group.
- Individuals seated higher or otherwise elevated (metaphorically or, in this case, literally) above others can frequently be assumed to have more power than those seated lower. This implies that GR and WR have a P value higher than that of any (?) of the soldiers.
- Within the groups, speaking and speaking first are generally signals of greater power—though this can sometimes be tempered if other signals of deference are observed, such as when a speaker is speaking for a leader, though these are largely absent in this scenario except, possibly, in the case of the interpreter CS. This would imply that LS has a higher P than any of the other soldiers, and GR has a higher P than WR.
- Within the soldier group, by the same logic as used to discriminate the two primary groups from each other initially, we would assume somewhat greater D between CS and the other two soldiers than between LS and RS. This is because minor variations in dress and ethnic appearance suggest a greater affiliation between LS and RS than between either of them and CS.
- Prior to learning of the context of interrupting an ongoing meeting from the Georgetown description, it was not apparent to us whether the meeting between the soldiers and the villagers had been planned or spontaneous and, if planned, at whose request. There is always some imposition stemming from the intrusion into the life of another by any meeting, but there was no a priori reason to believe that it was greater or less than some baseline in this case. On the other hand, the fact that it was an interruption of an ongoing meeting, especially a meeting called to discuss problems of terrorism, makes it a greater imposition than we would first have thought.

Given those facts and their associated implications, and given the rough scales for P, D and R proposed in 5.4 above, and the worked examples cited in 5.5, we would propose the following initial values for this scenario:

- *Power*—above we provided an anchor point of 100 for the power that a professor has relative to a freshman student or a parent over an early teenage child, and we

scored the relationship between a mayor and a corporal as 300. Here, we might guess that the soldiers have more relative power than the corporal in our earlier scenario (making the power difference number P lower), but the power difference gap is probably not as narrow as a professor and student. So, somewhat arbitrarily, let's assume that the power difference between any of the soldiers and any of the village leaders is ~150. Then, using the observations about power above:

- *P(LS, RS[5])*—We thought above that RS was likely to be the leader of the soldier group, but that CS was the lowest powered individual in that group. RS is a soldier on a mission, so he may slightly outrank LS, or may just have the leadership on this particular mission. This is close to, but probably slightly greater than, our anchor point on the power scale for the power relationship between project manager and project worker, which we scored as 10. So, let's call this value 20[6].
- *P(RS,CS)*—This power difference seems somewhat larger than that between LS and RS. Let's call it 50.
- *P(LS,CS)*—should be lower than between RS and CS, but probably larger than between LS and RS. Let's set it at 35.
- *P(GR,WR)*—GR appears to be slightly more powerful than WR, at least in this meeting, but at a guess, that power difference seems less than LS over CS. Let's call it 10.
- *P(GR,RS)*—Above, we claimed that the relative power difference between the two groups was ~150. The relative power difference between the two leaders should be perhaps somewhat less. Let's call it 120.
- *P(GR,LS)*—Since RS seems to have slightly less power than RS, let's call the power difference between GR and RS 150.
- *P(GR,CS)*—since CS has still less power than RS, let's call the power difference between GR and CS 180.

- *Social Distance*—our scale of social distance uses anchor points (for American culture) of -1000 for deep, old friends, spouses, etc., -100 for extended familiarity or reason to expect fairly friendly relations such as long term work colleagues, moderately extended family members (aunts, uncles), etc., and -10 for some casual friendship, acquaintance, but not deep friendship. The positive end of the scale is reserved for strangers with no closeness but no antipathy (10), those of differing race, socio-economic status, etc. in a context of mild mistrust (100), and those with some definite social antipathy such as members of the military and those known to oppose the use of military force, members of different (and opposing) religious groups, etc. The mayor and corporal were given a D of 3—only slightly higher than the midpoint of the scale. In this scenario, the groupings we perceive as Observer lead us to suspect that the D between the two groups will generally be higher than within the groups. Knowledge of the potential antipathy between GR and WR, however, might shift

[5] That is, the power that LS has H has over RS as S. The difference would be reversed if the roles were reversed.

[6] Actually, to maintain the formal structure of the equations presented earlier in this report, we should note that this value is the Belief of Observer O and, when it is entered into a Wx or Ix calculation, it should be weighted. To reduce clutter, we will skip this.

this slightly. Given these prior examples and this background knowledge, we would suggest the following D values for the scenario

- *D(LS, RS)*—This should be the closest of bonds in the group as these two soldiers are from the same organization (by uniform) and same cultural group. They have probably served together, we would assume. Thus, we would give this relationship a D of -100.
- *D(LS,CS)*—This relationship should not be as strong as the above, but they are still engaged in the same endeavor and have presumably worked together at least somewhat previously. Let's give it D= -10.
- *D(RS,CS)*—Presumably the same as between LS and CS: D= -10.
- *D(GR,WR)*—They are of the same ethnic group and region and have similar jobs, and have presumably met previously and even worked together on past occasions, but we are told (in the Georgetown background notes) that there may be some antipathy between them. Let's give them D = 0, partially to reflect the unknowns associated with their antipathy for each other.
- *D(GR,LS)*—They are strangers, meeting for the first time, from different organizations. Furthermore, there is some a priori antipathy between their roles. Let's call this D = 100.
- *D(GR,RS)*—As for LS: D = 100.
- *D(GR,CS)*—since CS shares a culture and language with GR, D should be less than with the soldiers. Nevertheless, there is no reason to assume they have had prior contact and insofar as there is antipathy between GR and the soldiers, CS will likely share in that. Let's call this D = 50.

- *Imposition*-- For Raw Imposition (R), a value of 0 means essentially no or negligible imposition—a minor task or request that one could ask of pretty much anyone. Values greater than 0 reflect increasingly large impositions, while those less than 0 are indicative of requests that are to the benefit of the hearer. Our scale anchor points for nominal American culture included -1000 for an invitation to do something deeply advantageous to the H (partake of food when hungry and poor, to receive a promotion or receive an honor, etc.; -100 for something advantageous to H—for example, to come over for dinner in the future, to attend a party, etc.; and 10 for an invitation to participate in something mildly advantageous—to have a cup of coffee or a beer, to borrow a minor object (book or movie), etc. At the other end of the scale, a value of -10 is characteristic of a minor request of minor advantage to S (e.g., directions in a neighborhood that H is familiar with); 100 is characteristic of moderate imposition—borrowing a moderate sum, asking for a ride to the airport, asking someone to watch your kids for an hour or pet for a few days; 1000 is characteristic of a large imposition—borrowing a largish sum, asking for a largish time commitment (help building a fence or writing a book), etc. Something personally distasteful increases the imposition factor. We had previously characterized the imposition in the corporal's request to the mayor as 10, in large part due to the assumption that it was a part of the corporal's duties. Given these anchors and prior cases, we would characterize the imposition of a normal greeting as comparatively small, and possibly even advantageous (negative imposition) for H. On the other hand, the fact that this greeting is interrupting an ongoing meeting serves to increase the imposition.
  - Let's characterize the general Rx (raw imposition) of this scenario as 50 for the soldiers addresing (and interrupting) the villagers, and -10 for the villagers addressing the soldiers (a mild advantage).

- This "raw" imposition should not fluctuate at least within the "micro-game[7]" of greetings and introductions exchange. Once the game shifts to something else (e.g., asking a favor), then a new raw imposition value may be asserted. Fluctuations in perceived politeness and face threat may well happen within the "microgame", but these will be the result of the types of redress used and, perhaps, the presence or absence of actions. For example, if A greets B warmly(e.g. "It's a great pleasure to meet you!") and B responds cooly ("yeah") or not at all, then B will have threatened A's face but this is a function of the redress used and not a fluctuation in the raw imposition of the greeting itself.
- Note too that the "game" being played is not the same between all participants. While there is a "greeting" interaction going on between the soldier group and the villager group, within the two groups the interactions are different and, perhaps, less well defined. Within each group, there may well be a subtle authority game being played—with LS leading the action and dictating phrases to be translated by CS, and with GR speaking first and for (?) the other villager(s). At any rate, since the primary action is the greeting game, and since we don't have much information to draw inferences about the other "micro-games", we will focus on the greeting exchange exclusively.

- *Character*—As with the mayor and corporal example, we know of no specific reason to suspect that any of the individuals involved, by virtue of their character, should be expected to be prone to using substantially more or less redress[8]. We will treat this value as 0 throughout.

With these assumed values, we now have enough information to compute the Weightiness of the perceived face threat for each of the primary participants in the greeting engagement. Where the core formula is:

[7] This not entirely developed concept of a micro-game points to the fact that we believe we are operating at a level lower than the "social games" proposed by Shapiro and others at UCSC. We view social games as broader and, likely, composed of specific "micro-games" or perhaps "moves" such as the greetings and introductions move discussed here. As one distinguishing feature, a micro game may be thought of as an exchange with homogenous level of imposition, while a full social game may well involve multiple, shifting levels. For example, an "alliance game" (as an example of a social game) certainly imposes constraints on how a greeting is performed, but there are likely to be multiple micro games in a social game—for example, greetings, introductions, small talk, offering compliments, offering favors, etc.

[8] Actually, the claim from the Georgetown notes that Ali (GR) is "high involvement" and frequently talks over and/or interrupts others might be indicative of a Character term and might be justification for increasing the Wx term by including a positive value for C. That said, we are not sure that this is the case (GR's behaviors may well be intended to be brusque and somewhat offensive) based on this little data and, furthermore, they seem that way to us as observers. For those reasons, as well as simplicity, we will keep C at 0 for all participants. Similarly, while our equations permit the use of alternate weightings for the various terms in the equation, we know of no basis on which to assign such weights in this scenario. Therefore, they will be omitted.

$W_x = D(S,H) + P(H,S) + Rx + C(S)$

Thus, in the greetings and introductions "micro-game" we obtain the values for Wx as shown in Table 6. These results match our intuition that the soldiers in general are showing more deference and are attempting to mollify any threat that might be present, while the villagers are somewhat less concerned about that (as, admittedly, they should be given that we created the values for P, D, and R on the basis of that

Table 6. Computations for Wx for the core participants in the greeting scenario.

Participants		Compnents			Total Wx
S	H	P(H,S)	D(S,H)	Rx	
LS	GR	150	100	50	300
GR	LS	-150	100	-10	-60
LS	CS	-35	-10		
CS	LS	35	-10		
RS	CS	-50	-10		
CS	RS	50	-10		
CS	GR	180	100	50	330
GR	CS	-180	100	-10	-90
RS	GR	120	50	50	220
GR	RS	-120	50	-10	-80

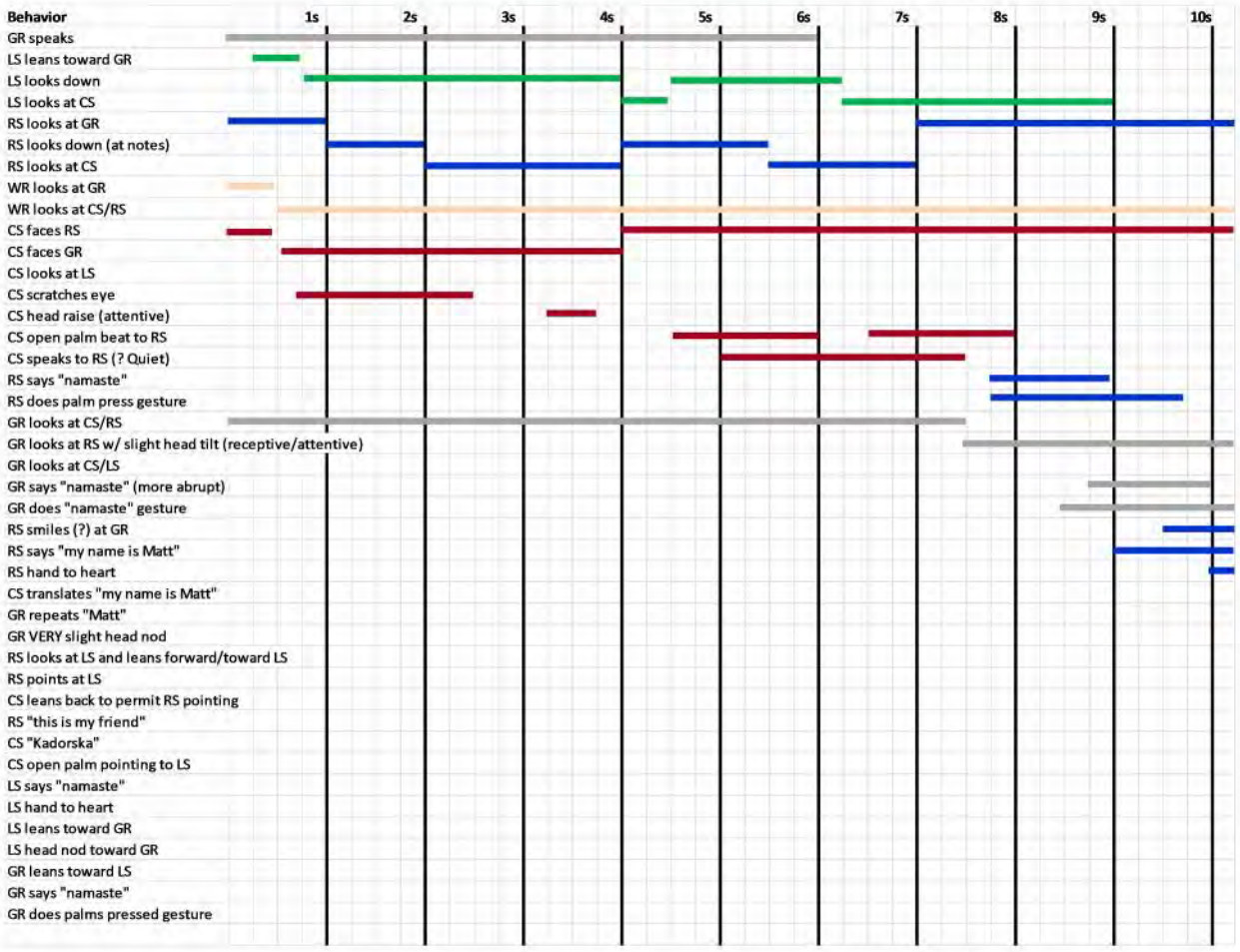


Figure 18. Timeline of the body behaviors noted in Scenario 1 (Bub and Mark Introductions)—Part 1.

assumption).

Note that we had not previously implemented any techniques for enabling characters in a simulation to dynamically assess the P, D, R and C values for other characters or human users they interacted with. Instead, these values were simply stored in a knowledge base representing the beliefs of that individual character. Similarly, we had not developed

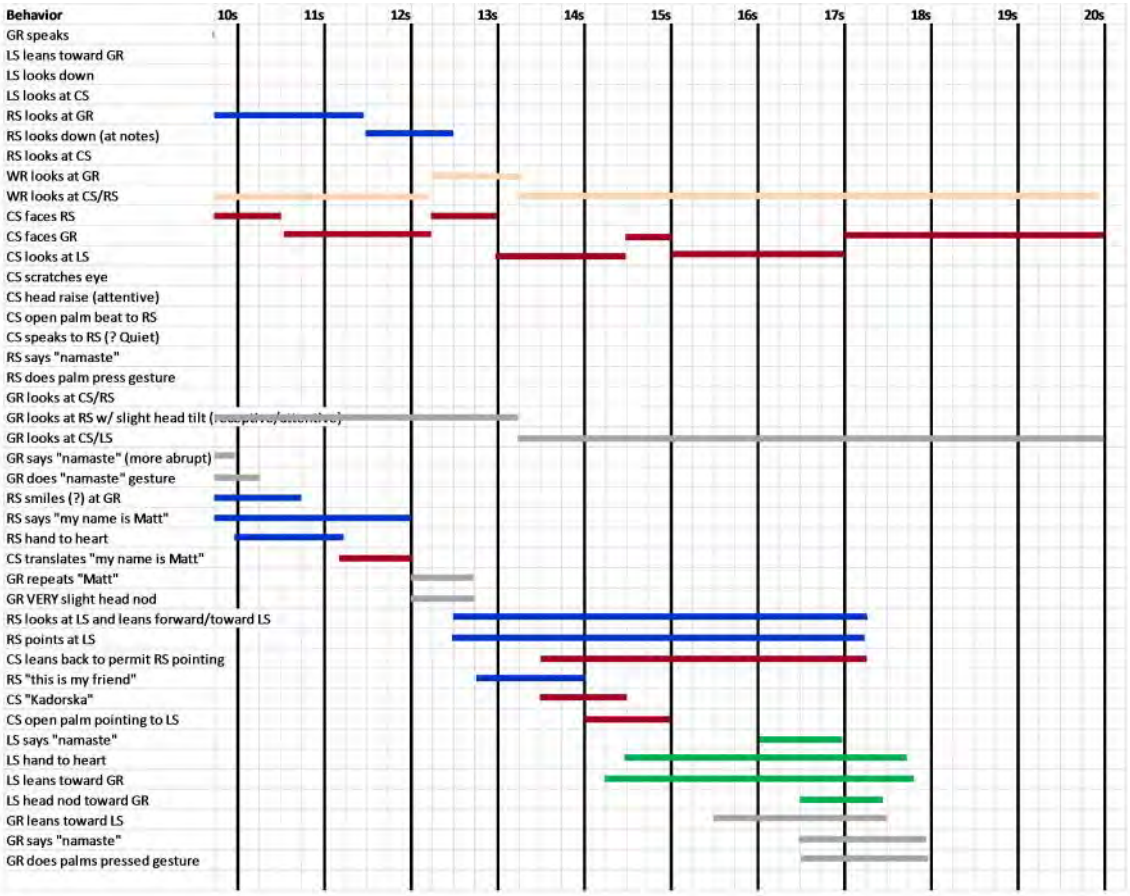


Figure 19. Timeline of the body behaviors noted in Scenario 1 (Bub and Mark Introductions)—Part 2.

techniques for dynamically updating those beliefs based on interactions and experience with an individual. These challenges are not tackled here either, though we note that the types of information reported in the bullet lists above (and, especially, as reported to us in the Georgetown notes on the scenario), such as physical groupings, seating positions, details of clothing, ethnic appearance, etc. are exactly the right kinds of information upon which to develop reasoning heuristics that would enable a simulated character to dynamically make such inferences.

9.2.3 Assigning V($\mathbf{A}_x$) Redress Values

Figure 118 and Figure 19 presents a timeline chart which identifies relevant verbal and body behaviors in the leftmost column and then shows the temporal interval in which that behavior occurred. Times are approximate and roughly accurate to the nearest quarter second and were derived from watching the video in slow motion. Line colors correspond to the different individuals involved in the scenario.

Behavior	Redress Value	Recip	Pos Face	Neg Face	Comments
GR Speaks					
LS leans toward GR	20	GR	X		leaning toward, especially as opposed to a space-enhanced "looming" can be regarded as a sign of attentiveness and therefore a sign of positive redress. Especially at the beginning of a "greeting micro-game" it would be very rude not to look at the person being greeted.
LS looks down	-10	GR	X		While LS is not the primary speaker (or primary listener) at this point, his failure to give attention to GR while speaking is impolite, especially since GR is speaking--as would be suggested by the VDR. Especially given that he is a lower status individual, his rudeness is exacerbated. OTOH, staring at notes is still, plausibly, a functional part of the engagement (as opposed to, say, engaging in another conversation), so the offense is mitigated
LS looks at CS	0	GR	X		This brief shift of attention away from the speaker (GR), especially when directed to the translator (CS) is probably reasonable and inoffensive. Looking to the translator, especially if reasonably done to receive a translation of what the speaker is saying, may be almost as good as looking at the speaker (but not quite)
LS looks at CS while GR is speaking	-5	GR		X	In addition to the positive politeness reasoning described above, the VDR would suggest that attending while the other is speaking conveys dominance of the other, thus a neg polite action. By extension, not attending to the speaker when he is speaking is an inverse negative politeness (an insult). We have represented this as a separate score
RS looks at GR	15	GR	X		As for LS above, a pos polite gesture.
RS looks at GR while GR is speaking	10	GR		X	In addition to the positive politeness above, the VDR would suggest that attending while the other is speaking conveys dominance of the other, thus a neg polite action. We have represented this as a separate score to provide a slightly higher score than otherwise
RS looks at GR while CS is translating	15	GR		X	As above, focusing attention on GR when his words are being translated but not actually spoken (i.e., ignoring the translator), seems particularly potent as a form of neg politeness given the VDR-based reasoning above, so we add this score
RS looks down (at notes)	-10	GR	X		As for LS above, an inverse pos polite gesture
RS looks at CS	0	GR	X		As for LS above.
RS looks at CS while GR is speaking	-5	GR		X	As for LS above.
WR looks at GR	--				ignored for this exaample
WR looks at CS/RS	--				ignored for this exaample
CS faces RS	0	GR	X		Facing (and presumably looking at) an individual is a similar form of attentiveness, giving positive polite redress. Since we are focusing on the relationship between RS and GR here, however, looking at someone OTHER than GR is tantamount to inattentiveness to GR, albeit instrumental attentiveness
CS faces RS while GR is speaking	-5	GR		X	As for other examples above, while this is part of his job (and therefore a mitigated insult) it is nevertheless power-threatening to not get attention when speaking
CS faces GR	15	GR	X		As for RS facing GR above
CS looks at LS	0	GR	X		As for CS facing RS above
CS scratches eye	-5	GR	X	?	This is at least inattentive and perhaps rude in the sense of attending to ones own bodily needs as opposed to the others. Scratching some body parts would be conventionally very rude, but we know no reason to extend this to the eye
CS head raise (attentive)	30	GR	?	X	In context, this could be a sign of increased attention or, on the part of the translator, an acknowledgement of what has just been said and agreement to begin translating. In either case, it is a somewhat more potent neg polite sign
CS open palm beat to RS	10	GR		?	This beat while the CS is speaking may be neutral, but it might also be an indication of emphasis-- passing along some nuance of power or emphasis that GR said. As such it would be a mild form of negative polteness. We're giving it half points as a result
CS speaks to RS (? Quiet)					
RS says "namaste"		GR			

Figure 20. Part 1 of the redressive scores applied to the the body behaviors observed in the scenario—along with explanations.

Figures 20, 21 and 22 convey the scores we have assigned to each of the body behaviors we noted in Figure 18 and Figure 19 along with some explanation or thoughts about why that behavior should be scored in that fashion. In all cases, we are basing our scoring on the approach we took for verbal behaviors in prior work, which was in turn based on our reading of Brown and Levinson, as augmented by the literature and models we reviewed in section. Key to this interpretation is the guidance provided by Brown and Levinson (and reported in sections 4 and 5.4 above, as well as partially illustrated in Figure 2) that positive redressive strategies (those that are affiliative, enhance positive face and emphasize fellowship and group affiliation, minimize social distance, etc.) are generally less potent than negative redressive strategies (that that are focused on dominance and

Behavior	Redress Value	Recip	Pos Face	Neg Face	Comments
CS speaks to RS (? Quiet)					
RS says "namaste"		GR			
RS does palm press gesture	60	GR	X	X	A strong gesture, perhaps made stronger still by accomodation to GR's culture (pos politeness), of positive politeness (giving gifts) and of decreased physical size and threat readiness (neg politeness)
GR looks at CS/RS	10	RS	X		As for similar attentiveness markers above; here we are scoring exchanges with RS so the split attention undercuts the value slightly, while the fact that the split is for/with a translator undercuts the undercutting.
GR looks at CS/RS while they are speaking	5	RS		X	As for similar attentiveness during speaking (based on VDR) assignments above, slightly undercut because other gestures and interleaved speech by GR are going on
GR looks at RS w/ slight head tilt (receptive/attentive)	20	RS	X		As for similar attentiveness markers above; here the shift of focus to RS exclusively, combined with the increased attentiveness earn more points
GR looks at CS/LS	20	RS	?	X	While this is clearly attentiveness directed away from RS, and might otherwise be taken as lack of attentiveness and negative face threat (per VDR), it is nevertheless exactly where RS is directing GR's attention, therefore the following of directed attention is in fact a fairly potent surrender of negative face wants.
GR says "namaste" (more abrupt)		RS			
GR does "namaste" gesture	-10	RS	X	X	While this is the same gesture as RS gives to GS above, it is done more briefly and perfunctorally. In practice, this could even be offensive. In fact, it is done OVER RS's gesture and speech, thereby preempting him. We will score it negatively as a result, with a strong temptation to score it even lower
RS smiles (?) at GR	40	GR		X	Per our lit review, smiles are more likely to be tokens of acknowledgement of dominance and hence, moderately potent neg politeness indicators
RS says "my name is Matt"		GR			
RS hand to heart	30	GR	X		This is, we believe, a non-formalized gesture which conveys a degree of sincerity. As such, it does not incur deference points (neg politeness) for acceeding to the other's culture, but does incur pos politeness points for friendliness
CS translates "my name is Matt"		GR			
GR repeats "Matt"	10	RS		X	We are scoring this, somewhat tentatively, as a verbal instance of mirroring, allbeit formalized and abbreviated. As such, in affords limited neg politeness to RS since he directed GR's attention here. The fact that the move is attenuated, combined with the fact that it is mimicing rather than complementary implies that this is a mild form of negative politeness.
GR VERY slight head nod	-10	RS	X	X	Again, a highly attentuated pos politeness gesture indicating acknowledgement, and deference (negative politeness via body posture minimization). The attenuation of it, though, conveys dominance and may even be more offensive
RS looks at LS and leans forward/toward LS	20	GR	X		We are interested in the effect on GR here, and this serves as an instance of RS "offering a gift" to GR in the form of an introduction to RS. A mild pos politness effect
RS points at LS	20	GR	X		A further effect of offering a "gift" to GR
CS leans back to permit RS pointing	10	RS		X	This is a fairly strong offering of deference (minimizing one's position so as to permit the other to hold sway) from CS to RS. For GR, though, this convey's little beyond CS' recognition of RS' authority.
RS "this is my friend"		GR			
CS "Kadorska"		GR			
CS open palm pointing to LS	20	GR	X	X	As translator, this is CS conveying RS' "gift" of the introduction. As such, it conveys that gift (pos politness) to GR, as well as conveying RS' authority (neg politness)
LS says "namaste"		GR			

Figure 21. Part 2 of the redressive scores applied to the body behaviors observed in the scenario-- —along with explanations.

submission, redress negative face and seek to mollify, reduce the responsibility for or directly apologize and perhaps incur a debt for the face threat, that minimize threat to power, etc.). We have previously operationalized this distinction as:

- The value of the use of an individual positive redressive strategy (see Brown and Levinson, p. 102, Figure 3, for a list of such strategies) will provide from 1 to 40 “units” of redress.
- The value of the use of an individual negative redressive strategy (see Brown and Levinson, p. 131, Figure 4, for a list of such strategies) will provide from 20 to 60 units of redress.

We tried using that valuation here, though as noted, by *only* scoring body behaviors we knew we were undervaluing the total redress. We ran into four challenges however:

Behavior	Redress Value	Recip	Pos Face	Neg Face	Comments
LS says "namaste"		GR			
LS hand to heart	50	GR	X	X	As for the namaste gesture performed by RS above, but minus a few points for missing the culturally appropriate gesture
LS leans toward GR	20	GR	X		As above
LS head nod toward GR	30	GR	X	X	more potent acknowledgement and physical diminuation than GR did above
GR leans toward LS	20	RS		X	While GR's action is directed at LS, it is at the direction of RS, hence we'll score these points for RS
GR says "namaste"		RS			
GR does palms pressed gesture	5	RS	X	X	Again, the statement and esp. the gesture are abbreviated relative to what LS did. Thus, we give it fewer redress points, and might even consider it offensive.

Figure 22. Part 3 of the redressive scores applied to the body behaviors observed in the scenario—along with explanations.

1. *The role of multiple parties*—The Brown and Levinson model, and our prior use of it, has focused on the face threat accruing to a single Hearer from a single Speaker. In principle, it should be easy to scale up using this pairwise approach to any number of participants in an interaction. There is reason to believe, however, that things aren't that simple—and this scenario illustrates a reason why. In the course of the introductions and greetings, there are multiple participants and multiple interactants. While WR never speaks, each of the other participants do. On the other hand, it is reasonably clear that GR and RS are the primary speakers and the leaders of the interaction, but that each "represents" a group—RS the group of soldiers consisting of himself, CS and LS, and GR the group of villagers consisting of himself and (at least) WR. Therefore, politeness or rudeness from anyone in either party "reflects" on the leader of that group. In this analysis, we were attempting to represent the effects of body behaviors on the computed politeness accorded to the two primary interactants (GR and RS), but this required representing the effects of the behaviors of the other participants to some extent. For example, when CS defers to RS by leaning back to allow RS to gesture to LS, we score this as an act of polite redress to RS. While GR has not "given" this redress to RS, it was done in his presence and therefore conveys redressive value to RS in the context to an outside observer (i.e., us). Note that VDR in particular, provides a more thoroughly realized approach to computing the effects of multiple actors, as outlined in section 7.1 above. In section 9.4 below, we illustrate the use of VDR to calculate *group* dominance via gaze as an exploration of this more aggregative approach.
2. *The role of the translator*—The presence of a translator is novel for our application of the etiquette model and somewhat challenging—as, indeed, it might be in social interactions in general. The VDR discussed in 7.1 above suggests that facing and gazing at a person while s/he is speaking is a polite gesture which affords redress and, usually, power/dominance to that individual. But in the case of a translator, the words being spoken are not the translator's in a sense, but rather the speaker whose words s/he is translating. For this reason, attention (i.e., positioned toward, gaze) to the translator instead of the individual who originally spoke, can seem less polite, especially if done extensively. It would still, likely, be more polite than doing something completely irrelevant, but not as polite as looking at the "author" of the initial words. Indeed, in another of the Georgetown videos, a different pair of soldiers is criticized for precisely this failing. To handle this situation, we have generally treated attention to the translator as similar to, but less potently redressive than, attention to the original Speaker.

3. *The role of directed attention*—Directing a Hearer's attention to something is itself a face threatening act—an impingement upon his/her autonomy (negative face). Nevertheless, when done at the appropriate time in a Greeting micro-game, we think it serves not as a threat, but rather as a "gift" (albeit, an expected one) of the introduction to other participants in the Speaker's team—a positive politeness action. Following the direction, then, is an acknowledgement and receipt of the gift—and act of deference and (minimal) obligation and therefore, an act of negative politeness. Particularly with regard to gaze direction, in this context, it becomes not rude/dominant to look away from the Speaker, but rather compliant to look where the Speaker is directing. We have scored particularly GR's actions using this understanding.
4. *The appropriate unit of analysis*—As will be shown below, scoring the duration and redressive value of different body behaviors allows us to compute threat, redress and Imbalance on a moment by moment basis at whatever temporal granularity is supported by our detection mechanism (in this case, our quarter second analysis granularity). But it is quite common for threat and redress to fluctuate repeatedly throughout an interaction (cf. [5]) with little or no ill effects. We suspect that humans are used to this fluctuation and pay little heed to it as long as things "balance out" over the long term. Therefore, we suspect that a reasonable unit of overall analysis is not the second-by-second effects of individual body behaviors, but rather the net effects of such behaviors (and the associated speech) taken over at least a "micro-game" as discussed above. We will illustrate effects at both the second-by-second level, and at the whole micro-game scenario level in the discussion below.

We presume that, in an implemented system, values such as those in Figure 20 through Figure 22 will be represented in a knowledge base corresponding to each individual. As for the P,D and R values in the previous section above, it is expected that beliefs about the redressive value (if any) of any given body behavior would have to be represented for each individual separately—though there would be cultural similarities between individuals from the same culture—and would represent that individual's beliefs about the redressive potency of various acts.

We have admittedly done nothing (beyond providing an initial and very partial taxonomy) toward developing techniques for recognizing such body behaviors from users of a simulation system, nor for generating them from characters within the game. This was not assumed to be our charter, though it represents a substantial challenge in its own right.

Finally, it is interesting to note that the bulk of the redressive actions used in the scenario emphasized positive politeness. While we did not consider this beforehand, in retrospect it makes sense: a Greetings and Introductions interaction is generally mostly about enhancing fellowship and removing barriers. While power dynamics will certainly be involved as well (as they are in this clip), it is perhaps not surprising that the bulk of the moves are targeted at positive face and the dimension of affiliation.

9.2.4 Computed Imbalance Scores

Since the Wx scores computed for Face Threat in section 9.2.2 above were scored for the scenario as a whole—what might be called the "Greetings and Introductions" micro-game—the redressive value $V(\mathbf{A}_x)$ can be examined either on a time unit by time unit basis or taken over the scenario as a whole. As discussed above, we believe that for most

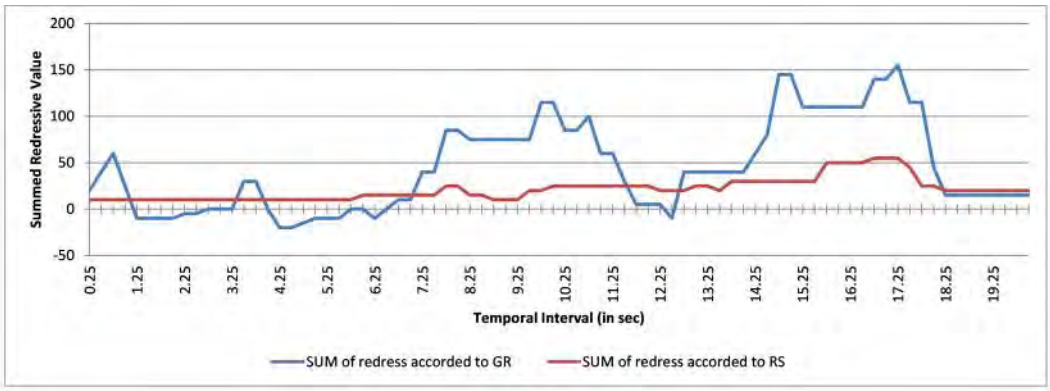


Figure 23. Summed redressive value accorded to GR and RS during each temporal interval of the scenario.

purposes, aggregating redress over at least a full micro-game will be appropriate, but for momentary interaction dynamics (such as might be detectable via physiometric or neurophysiological techniques), tracking the momentary politeness fluctuations might be more appropriate.

At any rate, the representation and scoring techniques we have developed support either approach. Figure 23 presents the momentary values of redress directed at both GR and RS throughout the scenario. These values were computed by "spreading" the redressive value scored for each body behavior act (as shown in Figures 20-22) over the time interval for that act (as shown in **Figure** 118 and Figure 19) and then summing the redressive values directed at that individual over the acts happening concurrently within that interval.

Figure 23 makes it clear that substantially more redressive value is accorded to GR during most temporal intervals during the scenario than is accorded to RS. Since (as indicated in Table 6 above), the weightiness of the Face Threat (W_x) from all of the soldiers to GR is positive for the scenario as a whole, while the weightiness of the threat from GR to each of the soldiers is negative, we would expect the soldiers to "work harder" to offset the threat.

We also note, however, that the larger amounts of redress are applied later in the interaction—from time 8-12.5 and from 13.75 to 19.25 when, roughly, RS begins his "Namaste" greeting and gesture, and then introduces himself and his fellow soldier. Earlier in the scenario, when GR is speaking, there is little that RS can do to increase the redress other than listen attentively—an action that, in fact, is undermined to some extent by his partner (LS) paying more attention to his notes than to GR.

We note also that the overall sum of redressive body behaviors scored in this scenario never exceeds 155 for GR and 70 for RS. This is in contrast to the W_x face threat values we computed of 280 when GR is addressed by RS, and -140 when GR speaks to RS (cf. Table 3.). In other words, if we were to compute Imbalance (I_x) of threat to redress on a moment by moment basis, we would be left with gross negative imbalance (rudeness) toward GR and somewhat positive imbalance (over politeness) directed at RS.

This is one motivation for looking instead at the overall redressive value directed at each individual throughout the "micro-game" scenario. When we score the value of each behavior once (regardless of the behavior's duration), and then sum the values over the full scenario, we arrive at the following V($\mathbf{A}_x$) values:

- Redressive value directed at GR (by RS and his team): 365
- Redressive value directed at RS (by GR): 80

Given the initial Wx scores, we arrive at overall Imbalance scores ($V(A_x)$-$W_x = I_x$) of:

- For GR: 365 - 220 = 145
- For RS: 80 – (-80) = 160

That is, from our outside Observer position, and given what we knew about the relationship a priori (as represented by how we scored P,D,R,C and the V(Ax) redressive acts), we conclude that both sides were being fairly "polite" to each other (mildly positive Imbalance scores). Furthermore, they were doing so at approximately equal levels.

Keep in mind that these represent only the body behavior scores. Adding in scoring of the verbal behaviors and the scores would rise—perhaps double.[9]

This is in no way to say that the two groups used approximately equal numbers or value of polite behaviors toward each other. In fact, the soldiers clearly used substantially more, and higher potency, redressive behaviors throughout. But the fact that their visit was an imposition, especially on GR, meant that in order for them to achieve the same level of redress that GR had, they needed to work much harder.

Furthermore, given what we know about GR and his attitudes toward RS (or, rather, American soldiers in general), and given that it was *his* meeting that was being interrupted, we perceive him as acting fairly positively in this encounter. This is not to suggest that RS would necessarily see it that way, especially without knowledge of the interrupted village meeting.

9.3 An Alternate Scenario

Since the power of the etiquette-based scoring approach can sometimes be better appreciated in contrast, we constructed a variant of the above scenario used above. While this scenario was not actually observed or recorded in the Georgetown videos, it is based on one that was. The interaction which observers reported as the worst of the three they observed involved soldiers who spent very little time either oriented toward the villagers by body posture or having their gaze focused on the villagers—even when the villagers were talking. Instead, they oriented toward the interpreter (our CS) throughout. See Figure 24 for a still image from this scenario.

A portion of this interaction was actually recorded and made available to us, but it involved a temporal period slightly later in the interaction than the "Matt and Bud" scenario analyzed above—a period in which RS was answering the question "why did you come to our village?" This represents a move into a different (and less formalized) "micro-game" and would have represented substantially more analysis effort on our part.

[9] This may be an argument that we are according too high a score to the redressive value of actions. If we are to move toward a system that counts both physical and verbal politeness, it may well be desirable to adjust the scales so that summing physical and verbal politeness retains the desirable feature of centering on zero. More test cases would have to be examined before making that recommendation more strongly, however.

Also worth noting is that this video involved a female soldier ("Lt. Jill") in the role of RS.

Figure 24. A still image from the alternate video in which the soldiers do not orient toward GR.

Since our time was limited, and since we wanted a direct comparison between alternate versions of the "Greetings and Introductions" scenario, we constructed a hypothetical, alternate version of the scenario we analyzed previously by simply altering some of the redressive actions taken, or not taken. This was roughly equivalent of projecting the behavioral patterns of "Lt. Jill" into the verbal interactions of the Matt and Bud from the scenario above. In other words, we had Lt. Jill and her team, as well as the villagers, say the same things that were said in the scenario above, but instead of keeping gaze and posture focused on GR, they tended to orient toward the translator, CS, instead. Furthermore, also in keeping with Lt. Jill's behavior patterns (which were physically very still and non-expressive), we removed the use of the palms pressed "Namaste" gesture and the hand to heart gestures.

Finally, we took advantage of the fact that Lt. Jill was female to illustrate another feature of our approach. While we do not actually know how GR feels about females or female soldiers, Hofstede [29] reports that Iraq is fairly high on his scale of Masculinity-Femininity and, therefore, it is not unreasonable to assume that a male village leader might feel increased imposition from, or increased power difference over, a female visitor interrupting a meeting he was conducting. We can model this feeling by a revision to the P,D,R, and C attributes which yield our W_x face threat weight. For our alternate scenario, we represented this factor by changing the P(H,S) from its value in the prior scenario (120 for GR as H and -120 for RS as H—see Table 3.) to the same value used for CS: 180 for GR as H and -180 for RS as H. This meant that the W_x value for RS speaking to GR was 280 (as opposed to 220 in the earlier scenario) and for GR speaking to RS, it was -140 (as opposed to -80 previously).[10]

[10] We should emphasize that we use this example, based on a real training interaction, only to illustrate how some gender effects can be captured in our representation. Gender differences may, in fact, make achieving polite (or powerful) interactions more difficult in some cultures—as illustrated in this example, but this is no reason in and of itself not to attempt them. Furthermore, "Lt' Jill's" poor gaze and orientation skills have no association with her gender, and could just as easily have happened to a male trainee.

Figure 25 shows, in red, the changes to the initial scenario that were made in this alternate scenario. All other behaviors were included at their initially scored values.

When these changes were made, the resulting moment-by-moment redressive graph is shown in Figure 26. By comparing this figure to Figure 23 above it should be immediately apparent that the redress accorded to GR is generally not as high, does not reach as high a peaks, and is more frequently below that accorded to RS than it was for the previous scenario.

Perhaps more telling is the overall redressive value directed at each individual throughout this alternate scenario. These values were:

Behavior	Redress Value	Recip	Pos Face	Neg Face
GR Speaks				
LS leans toward CS (not GR)	0	GR	X	
RS looks at CS (not GR)	0	GR	X	
RS fails to look at GR while GR is speaking	-5	GR		X
RS looks at CS (not GR) while CS is translating	0	GR		X
CS speaks to RS (? Quiet)				
RS says "namaste"		GR		
RS fails to do palm press gesture	0	GR	X	X
GR says "namaste" (more abrupt)		RS		
RS says "my name is Matt"		GR		
RS fails to do hand to heart	0	GR	X	
CS translates "my name is Matt"		GR		
GR repeats "Matt"	10	RS		X
RS "this is my friend"		GR		
CS "Kadorska"		GR		
LS says "namaste"		GR		
LS fails to do hand to heart	0	GR	X	X
LS leans toward CS (not GR)	0	GR	X	
LS head nod toward CS (not GR)	0	GR	X	X
LS fails to look at GR when GR is speaking	-5	GR		X
GR says "namaste"		RS		

Figure 25. Changes to the representation of the "Matt and Bud" scenario that were made to score and analyze our alternate scenario representing a less polite interaction.

- Redressive value directed at GR (by RS and his team): 105
- Redressive value directed at RS (by GR): 80

The previous values were 365 and 80 respectively, so the lack of orientation and attention, as well as the omission of the gestures substantially reduced the redress given to GR. Furthermore, given the initial W_x scores, the overall Imbalance scores ($V(A_x)$-W_x = I_x) are:

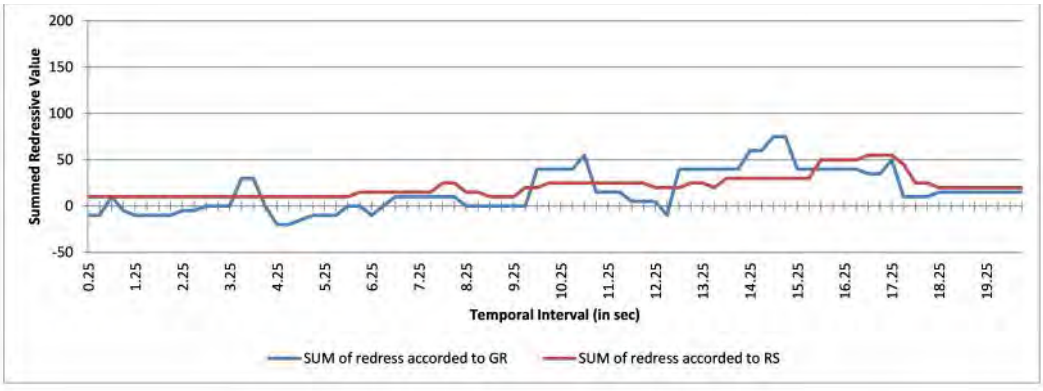


Figure 26. Summed redressive values accorded to GR and RS during each temporal interval in the alternate scenario.

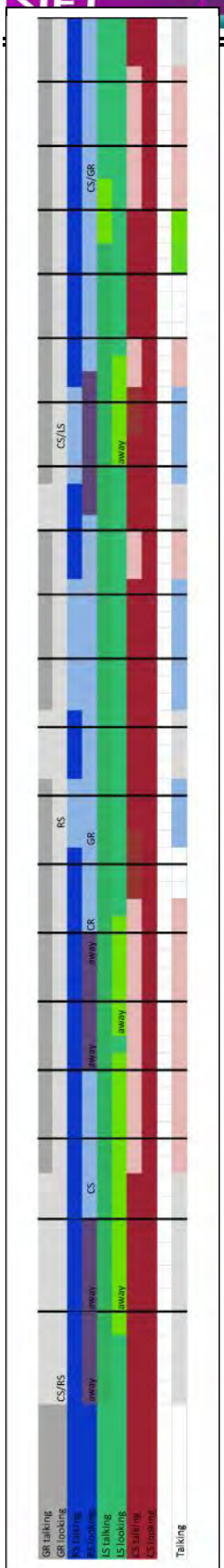


Fig. 27. VDR Timeline.

- For GR: 105 - 280 = -175
- For RS: 80 – (-140) = 220

These values were 145 and 160, respectively, previously.

That is, the omission of the polite gaze and gestures from RS and her team (combined with tension over the presence of a female soldier combined to turn the interaction with GR from a mildly positive one to a mildly negative one in this hypothetical scenario. Furthermore, instead of reaching approximate parity in accorded politeness levels, GR is now perceived as being quite polite to RS, while RS has been fairly rude to GR. More importantly, this simple example serves to illustrate how our representation and etiquette scoring approach can be sensitive to minor variations in body behaviors—resulting in substantial modifications to the perceived politeness of the outcome.

9.4 Calculating the VDR using SSIM training video

As noted above, one of the weaknesses of our approach, which we are only partly overcoming in the above examples, is that it is geared to compute the relationship between one Speaker and one Hearer. In practice, multiple individuals may be involved in an interaction even if they are not actively speaking, and their behaviors will and should have an impact on the perceived politeness (and power, familiarity imposition, character and redressive value dimensions which comprise it) which results. This is particularly true of body behaviors, which as we noted above, may go on contiguous with speaking.

The Visual Dominance Ratio described in section 7.1 above is an approach we learned about from the literature for computing either a pairwise or a groupwise gaze ratio which has demonstrated correlates with perceived dominance. We took the step of applying it to the same scenario we analyzed above (in section 9.2) to see if it provided parallel results.

Based on the sample scenario described in section 9, we calculated visual dominance ratios for the four main actors in the "Matt and Bud Introductions" video. To calculate the VDR for each person, we analyzed the video 1 and identified variables for "looking while talking (lwt)", "looking away while talking (talking away)", "total time talking (talking)", "looking while listening (lwl)", "looking away while listening (looking away) and the total amount of "group talk" (minus the person for who the ratio is being calculated), not listed in this table. These intervals are presented in the timeline in Figure 27. The VDR was calculated for 4 out of 5 visible actors in the video, using Formula 2 in Table 3 above (based on Koch, [43]). It reflects the visual attention that a person A pays to all team members dependent on A's and the group's speaking mode (i.e., A talks or A listens while team members are talking). The numerator consists of the proportion of the entire speaking

Table 7. Visual Dominance Ratio for 4 group members.

GR#wt	4.8	RS#wt	3	CS#wt	8.25	LS#wt	1
GR#talking	4.8	RS#talking	4.5	CS#talking	8.25	LS#talking	1
GR#wl	15	RS#wl	10.75	CS#wl	11.75	LS#wl	13.25
GR#looking#away	0	RS#looking#away	6.25	CS#looking#away	0	LS#looking#away	5.75
GR#talking#away	0	RS#talking#away	1.5	CS#talking#away	0	LS#talking#away	0
GR#/DR	1/1.090	RS#/DR	0.33/0.320	CS#/DR	1/7.9479	LS#/DR	1/14.312
VDR	**0.91667**	**VDR**	**1.040741**	**VDR**	**0.12582**	**VDR**	**0.06987**

time of A that A looks at any group member. The denominator consists of the amount of the other group members' total speaking time that A looks at any one team member but does not talk. The formula was applied to each actor in the clip. Koch [43] proposes further adjustments for the times when a person is not visible. However, for this sample our adjustments are based on heuristics.

The results of the analysis are presented in Table 7. They show the highest VDR for RS (blue) of 1.04, and the second-highest for GR (grey) of 0.92. CS (red) and LS (green) both had substantially lower VDRs: 0.13 and for 0.07 respectively.

The calculations are based on the 20 sec video and the results are likely impacted by the staged nature of the scenario, i.e. "looking away" is often impacted by the soldiers looking at their notes, i.e. only LS and RS have "looking away" time. For example, the high VDR for RS is likely due to the fact that he was looking away (at notes), but also because he was looking away while talking to GR for a brief moment – a sign of inattention or "dominance". The others were being more attentive when speaking, i.e. their ratios of "looking while talking/total talking time" are equal and therefore 1. The ratios also reflect more or less equal dominance between GR and RS, while the VDR of CS and LS are much lower. It should also be noted that CS (the translator) is treated the same way as everyone else, even though his assigned role is one of a facilitator, that shouldn't (but does) impact VDR calculations. For example, it would be considered "more polite" if soldiers look at the person they *intend* to talk to, instead of the translator – something we did not take into consideration in this analysis.

While this is only one aspect of body behaviors, it does reflect accorded attention (a positive redress behavior) and deference or lack of deference (a negative redress behavior) quite powerfully "redress". Over time, redress effects are built up. In this scenario, RS and GR are clearly the more powerful individuals, since others look at them when they are talking, while CS and LS are lower status individuals. The notion of dominance, however is conveyed by "getting away" with inattentiveness. This has its parallel in Brown and Levinson's model in that (all other things being equal) more powerful individuals can use less redress to achieve balanced face threat to less powerful individuals. But a weakness of the VDR is that, unlike Brown and Levinson, it does not take a baseline set of expectations into account. Therefore, while it is true that the soldiers generally used more dominant gaze behaviors in this scenario (by virtue of their looking at their notes or each other rather than GR), this says nothing about whether an observer felt they were justified in doing so or not. As illustrated in the examples in sections9.2 and 9.3 above, at least given our formulations of the beliefs of ourselves as Observer, this was not the case. Instead of seeming dominant, the soldiers (particularly LS) seemed borderline rude. On the other hand, the VDR formula provides a better way

of incorporating all the gaze and speaking time data from all the individuals in an interaction into a single metric than does our politeness calculations.

It should be noted that the intervals used in the timeline for this analysis do not exactly match those in Figures 18 and 19 used in the politeness analyses. This is because they were done at different times by different individuals who had different interpretations of various action intervals in the video. This points to another source of variability in the production of subtle physiological phenomena such as these.

10. Summary and Conclusions

The results of this extended examination of the applicability of our politeness model and "Etiquette Engine" to the task of representing body behaviors and their impact on perceived politeness and the contributing factors which politeness mediates (power, familiarity, imposition, character and the value of redress) shows that such behaviors can be readily incorporated into our framework and body behaviors can successfully be represented as contributing to positive or negative redress. Furthermore, the combined effects of modeling body behaviors as redressive behaviors, using scoring techniques ported from our initial linguistic approaches, provided reasonable outcomes (in that they roughly matched our intuitions or intentions about the scenarios) in both the initial textual "stories" in section 8.1 and then in analyzing the "live" training interactions in section 9.2 and a hypothetical variant on it in 9.3.

We cited challenges associated with continuous body behaviors in our initial list of anticipated challenges (cf. section 3) but this may turned out to be more opportunity than problem. In section 9.2.4 and Figures 23 and 26, we attempted a technique that "spread" the redressive value of a body behavior over the interval of that behavior and, as a result, were able to produce moment-by-moment charts of perceived redress which track an interaction. We know this approach uses many simplifying assumptions (including avoiding our suspicions that the impact of body behaviors grows initially and then attenuates—as illustrated in Figure 15) and it ultimately proved less useful for assessing the "net" imbalance in an interaction than did the simple difference of Redressive value (counted on a per action basis) and Face Threat Weight—as we had used previously.

We have become aware that, in prior work, we were likely subsuming the effect of body behaviors in our scores of linguistic behaviors. Counting both of them together likely overweights the redressive value present in an interaction—and will tend to distort the behavior of our scales and their presumed "balance point" around zero. If this work is carried forward, we would suggest halving the value of both linguistic and physical behaviors relative to the scales and values assigned in the examples provided here.

Of course, substantial challenges remain. Many of these are listed, along with thoughts about possible solution approaches, in section 8.2. Chief among these are that all of the scenarios worked in this document involved hand-crafted recognition of both the redressive values and the contributing factors pertinent to face threat weight. Such capabilities, in all their subtlety, cross cultural variation and context-dependency (as also cited in our initial challenge list in section 3), would have to be automated for the full use of this approach in a simulation or gaming environment. Our prior work has demonstrated some ability to accomplish this for textual entries, but doing it for arbitrary body behaviors will likely be more challenging still. Acquiring and representing this knowledge is, itself, perhaps the greatest practical challenge—as mentioned in 8.2.9.

But we have demonstrated that our etiquette-based approach holds promise and can be extended to capture specific types of body behaviors with redressive value along with their effects on overall perceived politeness. Future research and development may explore more specific applications and seek to solve problems that we can only note and suggest approaches to addressing.

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13.4 MacroCognition Final Report

MacroCognition Final Report Begins on the Following Page

Filename: MacroCognition LLC Final Report 30March15

MacroCognition Raytheon BBN Technologies Report

Raytheon BBN Technologies
Purchase Order 9500011008 (Prime Contract No: W911-12-0002)

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Table of Contents

Executive Summary

The 42-month DARPA program, Strategic Social Interaction Modules (SSIM) has come to an end, and the purpose of this document is to describe the contributions of MacroCognition LLC to the effort under Raytheon BBN Technologies Prime Contract No: W911-12-0002 (Purchase Order: 9500011008). The intent of the overall program, nicknamed the Good Strangers program was to enable warfighters to learn the social skills necessary to have successful social encounters with civilians while stationed in foreign countries. The objective of Raytheon BBN Technologies was to design and implement innovative tools for training human interaction dynamics. This training will be implemented in an immersive, interactive, simulation environment that provides the trainee with the opportunity to develop, exercise, and adapt social interaction skills, while executing specific military tasks and engaging virtual humans in unfamiliar cultural, linguistic, geopolitical, and geographic settings. MacroCognition LLC's goal was to assist in the design and implementation of training tools through two major efforts – 1) the GS diagnostic tool (Gap Study), and 2) Gary Klein consultation.

Using Cognitive Task Analysis (CTA) interview data collected in Task Area 1B-Phase I, MacroCognition LLC constructed a summative study that sought to identify the cognitive, behavioral and perceptual gaps between the Good Stranger (GS) skills needed and those possessed by the military personnel. Researchers and practitioners are often tempted to transform expert knowledge and skills into training requirements. However, this is a mistake because trainees are not all alike. Some trainees already possess these advanced skills, while others may have deficits. Therefore, our goal was to investigate the training requirements for GS skills (identified by the TA1B team and our CTA research; see Appendix A), and examine a general military population to assess which of the GS skills identified were relevant as training objectives. We constructed the GS diagnostic tool obtain a rough estimate of the number of soldiers that already identify as GSs, and to measure the existing gap between the current skill set of soldiers and the skill set needed to be GSs (see appendix B).

An exploratory study was performed at Ft. Benning using 138 Non Commissioned Officers (NCOs) who individually completed an extensive diagnostic assessment containing scenarios and forced choice responses (e.g. ranking alternatives, multiple choice, Likert Scales; see Appendix C). Because of errors and incomplete responses, only 78 NCOs generated usable data records. The study employed three distinct sections (Frames, Learning Objectives, and Competency) to address the following training questions.

1. Do the NCOs self-identify as GSs?
2. When given forced choice questions with other high level goals (e.g. security, mission accomplishment), are their choices consistent with GS behaviors (e.g. de-escalation, rapport building, voluntary compliance)?
3. When queried about de-escalating situations and handling civilian challenges, do they provide evidence of the GS skills?

Theoretical Contributions

Using the diagnostic assessment, we found that GS frame is significantly associated with preference for GS skills (e.g. de-escalation, building rapport) and negatively associated with excessive security. Further, authoritarian frame preference was significantly associated with

decreased prioritization and understanding for certain trust building tactics (see Appendix D). These results further confirm the link between the GS frame and specific trust building tactics (G. Klein, H. Klein, Lande, Borders & Whitacre, 2015).

Training Implications

Our findings indicate that most of the NCOs self-reported as GSs. More specifically, they highly prioritized options manifesting the GS framework in comparison to other cognitive frames (e.g. mission, rules & procedures, authoritarian). Although most preferred the GS frame, far fewer soldiers showed GS proclivities or competency for the GS skills such as rapport building and perspective taking. Perhaps most striking, soldiers least preferred and were least confident performing rapport building actions, such as showing empathy and searching for common ground. For more training suggestions see Appendix E.

General Consulting

An ongoing collaborative effort between MacroCognition LLC and Raytheon BBN Technologies included, Gary Klein providing general consulting on the design and implementation of simulation tools for training cultural interaction skills. He provided his expertise in decision making, common ground, cultural cognition, training, sensemaking, and expertise to advise what training objectives need to be emphasized and what can be minimized – distinguishing the low-hanging fruit (low cost, low effort, high impact) from high hanging fruit (technological challenges with little payoff).

More specifically, Gary Klein provided on-call consultation on the Task Area II effort. This took the form of telephone calls and participation in the TA2 teleconferences, particularly in the early stages of the program, multiple visits to BBN headquarters, and a site visit to UC/Santa Cruz. The purpose of these activities was to share the results of the CTA study from Task Area 1A with BBN and its partners in order to improve the design of the simulation.

Summary

MacroCognition has made a variety of contributions to the BBN effort:

- Creating a sensemaking model of a GS
- Providing consultation on the design and implementation of the simulation tools
- Constructing a usable diagnostic tool
    - Assessing the GS potential of NCOs, to become GSs
    - Provide relevant training suggestions for researchers, trainers and practitioners

References

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Appendix List

A. Good Stranger KSA List
B. Good Stranger Diagnostic Tool (Gap Study)
C. Fort Benning – Trip Report
D. Good Stranger Diagnostic Tool: Measuring Capacities and Limitations to Inform Training (Naturalistic Decision Making 2015 Conference Proceedings)
E. Training Implications Addendum
F. Police and Military as Good Strangers (Journal of Occupational and Organizational Psychology, 2015)

Filename: GS KSAs 2.27.13

Good Stranger KSAs

Gary Klein & Helen Altman Klein

The purpose of this memo is to list the features that differentiate Good Strangers (primarily in the military) from others. These features are the basis for categorizing individuals as GSs. They also suggest themes for building scenarios – types of choices that will help shift people to a GS frame.

1. Preferring voluntary to coercive compliance from civilians.
2. Looking for chances to interact with civilians and build trust.
    a. Seeks to gain at least basic language skill.
    b. Eager to adopt local customs and standards of polite behavior.
3. Being irritated with Bad Strangers – colleagues who can get them killed.
4. Appreciating role models who are GSs.
    a. Speaking softly and calmly.
    b. Not getting agitated.
    c. Not generating fear or antagonism.
5. Refusing to take provocations personally.
    a. Able to laugh at self; doesn't take self too seriously.
6. Ready to resolve disagreements rather than avoiding them.
7. Curious about the reasons for odd behavior.
    a. Especially when dealing with foreign cultures.
    b. Able and eager to take another perspective.
    c. Assuming there is probably a good reason for the behavior.
8. Aware of long-term consequences of (positive)(negative) encounters.
9. Appreciating the tricks of the trade used to gain voluntary compliance.
    a. Verbal formulas
    b. Win/win ways to frame disputes.
10. Desiring a reputation for being fair and trustworthy.
11. Careful not to project arrogance or domination or intimidation.
12. Able to defuse a conflict. Prepared to make himself/herself vulnerable.
13. Believes in "policing our own." Speaks out when colleagues are out of line.

The SSIM Gap Study

U. S. military personnel are deployed in more than 150 countries around the world. This means that about 160,000 active-duty personnel serve outside the United States and its territories[1].

The Gap Study is sponsored by the Defense Advanced Research Projects Agency (DARPA). It is designed to collect information that can provide better support to U.S. military personnel deployed abroad. The training that will be developed from this study will only be as good as the information you share with us today. We will ask you to make decisions about real incidents that U.S. military personnel experienced during foreign deployments. We have selected these incidents from hundreds of pages of interview transcripts with U.S. soldiers about their experiences overseas and from other print and audio records.

The GAP material has three sections. In Section 1, you will review 10 brief scenarios and decide on the course of action that you would choose for each. In Section 2, you will review 5 complex scenarios - each presenting different challenges, suggesting different courses of action, and offering different choices. You will be asked about your concerns, priorities, and choices. In Section 3, you will be asked how you would accomplish the goals for scenarios described in Section 2.

[1] "Total Military Personnel and Dependent End Strength By Service, Regional Area, and Country". Defense Manpower Data Center. March 31, 2014.

Before beginning this study, we need to review the Consent Form that details your rights as a participant and our obligations as researchers. Please wait for instructions before continuing.

I. Brief Scenarios

Read each of the following 10 scenarios and then rank the four actions: 1 = the action that you believe is the best choice, 4 = the action you believe is the worst choice. For each scenario, use each ranking (1, 2, 3, & 4) only once.

1) Illegal Weapon. You are at a checkpoint searching for weapons. An Iraqi man enters the checkpoint. The man's background check comes out clean but you see what looks like a pistol under a blanket in the backseat. You know that pistols are not allowed in vehicles. Rank these actions from best (1) to worst (4).

Rank	***Actions***
	a. Investigate the backseat to confirm the presence of a weapon. Follow the procedure for confiscating and securing an illegal weapon.
	b. Direct the man to drive his vehicle out of the way to keep the checkpoint moving. Once off to the side, explain your responsibility for public safety.
	c. Ask the man why he is smuggling the pistol though the gate. While you can't arrest him, detain him for a while to show that you are in control.
	d. Ask the man why he needs a pistol and what threats worry him. Explain that your mission is maintaining safety.

2) Guarding the Money. You are leading a small team escorting a shipment of money to a local Iraqi bank. The bank has not been able to pay pensioners for days. This has upset many local people. When you arrive, you see elderly people gathering around the bank and demanding their money. The bank manager tells you that they will not be able to open the bank until the next day. He must first take inventory of the money. As you finish the escort, you notice a growing crowd of elderly civilians moving towards the bank doors. Rank these actions from best (1) to worst (4).

Rank	***Actions***
	a. Establish a perimeter around the bank to prevent anyone from entering. Have your soldiers stand with their rifles visible to establish your authority
	b. Have the bank manager address the local people. He should apologize for the delay and explain that the bank will open the next day.
	c. Complete your escort mission and inform the bank manager that he is in charge of handling the situation as you are leaving.
	d. Carefully follow all rules regarding interactions with local business owners and citizens.

I. Brief Scenarios

Read each of the following 10 scenarios and then rank the four actions: 1 = the action that you believe is the best choice, 4 = the action you believe is the worst choice. For each scenario, use each ranking (1, 2, 3, & 4) only once.

3) Local Laborers. A number of local people work on the base to support maintenance operations. Each day, a few of them arrive for work after the beginning of their shift. This makes it difficult to complete the assigned maintenance tasks and puts pressure on the other workers. Rank these actions from best (1) to worst (4).

Rank	***Actions***
	a. Fire the worst offender and announce that you'll no longer tolerate late arrivals. Other workers will understand that promptness is important.
	b. Review the work schedule to see if there might be a way to stagger shifts to get the work done and still accommodate different arrival times.
	c. Talk with the men who habitually arrive late to better understand why. If possible, address the reason for their problem(s).
	d. Review the job description to see if the time of arrival is clearly stated and if any penalties for late arrival are specified. Follow the guidelines.

4) Suspicious Behavior. You are assisting at a checkpoint near a neighborhood known to harbor insurgents. Protocol requires that you thoroughly check every car that enters and exits. A local resident you recognize drives up to the checkpoint. The man is usually pleasant and co-operative. Today, however, he says he needs to rush and asks that the check be hurried. Rank these actions from best (1) to worst (4).

Rank	***Actions***
	a. Examine the car and ask the questions that are on your checklist. Although he is in a rush, do not express favoritism towards the man.
	b. Ask why he is in a hurry so you can to identify potential village security problems. Carry out the search as quickly as possible.
	c. The man's urgency is suspicious. If he doesn't respond to your questions, remove him from his vehicle forcefully if necessary. Search him and his car.
	d. Expedite the check as long as the man is compliant. Watch for changes in his behavior that might signal potential threats. Keep alert to oncoming vehicles.

I. Brief Scenarios

Read each of the following 10 scenarios and then rank the four actions: 1 = the action that you believe is the best choice, 4 = the action you believe is the worst choice. For each scenario, use each ranking (1, 2, 3, & 4) only once.

5) Disaster Relief. Your squad is providing security assistance during a disaster relief operation in Chile. As you finish a regularly scheduled neighborhood walk-through, a team member spots a stranger running towards a nearby house. You are familiar with the family that lives in the house. You approach the house and ask the homeowner if he has seen strangers in the area or heard anyone trying to enter his house? The man says "No" and starts to close his door. Rank these actions from best (1) to worst (4).

Rank	***Actions***
	a. Allow him to save face. Suggest that a stranger may have entered through a back window without his knowledge. Search the home respectfully.
	b. Insist that you search his home. Check the house carefully following the rules and procedures specified for this situation.
	c. State that you must search his home. Enter the home without consent if necessary. Take any steps needed to subdue resistance and ensure security.
	d. Your mission is to reduce potential threat. Before searching the house, have the man move his family to a safe location.

6) Angry Teens. You and your men are inspecting an Iraqi radio intercept site you've found. You've been in this town for some time without any hostilities. As you carry out the inspection, a group of teenage males approach the site. You suspect that they are looking for bags of food they stashed at the site and that you are in their way. They don't appear to have weapons, but they look angry. Rank these actions from best (1) to worst (4).

Rank	***Actions***
	a. Greet the teenagers without drawing your weapons because your team is alert to potential danger. Ask the teens if you can help them.
	b. Complete the inspection as required keeping a careful eye on the teenagers. Follow rules related to any potentially hostile civilian actions.
	c. Have most of your team complete the inspection. You and several others should engage the teens to identify possible threats.
	d. Intimidate the teenagers by ordering your men to get into a low ready position. Direct the teenagers to follow your commands so you can search them for weapons.

I. Brief Scenarios

Read each of the following 10 scenarios and then rank the four actions: 1 = the action that you believe is the best choice, 4 = the action you believe is the worst choice. For each scenario, use each ranking (1, 2, 3, & 4) only once.

7) Security vs. Convenience. You are stationed at a U.S. base that also houses a contingent of Afghani soldiers. A gate near the Afghani quarter is very close to their latrine but it must be kept locked at night for security reasons. The Afghanis have been told that the gate must always be locked. The gate, however, is often left unlocked. Rank these actions from best (1) to worst (4).

Rank	***Actions***
	a. Review the reasons for your concern with the Afghani soldiers. Try to find a solution with them so that you can avoid locking the gate indefinitely.
	b. Tell the Afghanis the short-term and long-term consequences you will have to impose if the gate is found opened again. Keep your word to the letter.
	c. You can't take security lightly. Lock the gate the next time it is found opened. Tell them you will open it as soon as they come up with a viable solution.
	d. Your concern is security, not their convenience. Next time it is left unlocked, order that it is permanently closed.

8) Mine detection in South Sudan. As part of a U.N. peacekeeping mission, you have orders to support a land mine detection team as they search a wooded area. Because this can cause dangerous explosions, families living nearby were ordered to leave their homes and land for several days. They were promised monetary compensation for their trouble. When you arrive, you find that one family has not started to prepare. It is important that the family leaves so that the work can begin. Rank these actions from best (1) to worst (4).

Rank	***Actions***
	a. Order the owner to immediately gather his necessities because he is delaying the detection team's work. Tell the team they can get to work.
	b. Reassure the owner that his valuables will be safe while he is gone. This may delay the work a bit but will create a better feeling.
	c. The owner had time to gather his possessions before you arrived. If he is noncompliant, remove him and his family forcefully.
	d. Assign your squad members to help the owner gather his valuables if this will allow you to get work started sooner.

I. Brief Scenarios

Read each of the following 10 scenarios and then rank the four actions: 1 = the action that you believe is the best choice, 4 = the action you believe is the worst choice. For each scenario, use each ranking (1, 2, 3, & 4) only once.

9) A Negligent Local Contractor. A local contractor was hired to remove trash from a school construction site. He was told that the work had to be completed in two weeks so that the school could open on schedule. Three days before the deadline you notice that he has not yet started work. Rank these actions from best (1) to worst (4).

Rank	***Actions***
	a. If you are not contractually required to pay the contractor, dismiss him without pay.
	b. Tell the contractor that school must open on time. Tell him you must replace him and that you will work closely with him if he is employed at the base in the future.
	c. Fire the contractor and let the community know the delay was the contractor's fault. Local people will understand that they need to honor commitments to the U.S Army.
	d. Replace the contractor immediately with one who is available and who has a reputation for good work even under pressure.

10) Neighborhood patrol. Your squad is patrolling a neighborhood to provide security. These patrols are usually uneventful as the neighborhood has been peaceful for quite a while. A team member spots a young child dropping what looks to be a grenade from a second-story window of a home. He yells, "Run! Run!" Fortunately, there was no explosion and no panic. You see that it was actually a stone. Rank these actions from best (1) to worst (4).

Rank	***Actions***
	a. This prank could have lead to serious consequences. Enter the home and tell the parents that it is their responsibility to prevent this from happening again.
	b. Before you continue your patrol, record the details of this incident in your field journal. It's your job to keep a log of all unusual events.
	c. Though unsettling, this incident should not interfere with your checking the remaining area. The incident may have been a distraction.
	d. Knock at the door and tell the family what you've observed. Take the time to explain your responsibility for neighborhood safety.

Please wait for directions to begin the next section.

II. Complex Scenarios

Scenario #1: Broadsided

Background
You are a staff sergeant in a brigade motor pool. You have heard rumors that the Iraqis are intentionally hitting U.S. vehicles to collect compensation from the U.S. Government. You recently received a memo alerting drivers to be especially careful and to stay on lookout for accidents that look suspicious.

While working dispatch, you receive a radio call from a four-vehicle convoy. One of their trucks has had an accident with a civilian vehicle. There are no serious injuries and the truck does not need a tow, but the soldier reporting the accident sounds very tense and says you should get out there soon.

When you arrive at the accident site, you see the U.S. truck in contact with an Iraqi vehicle's damaged hood. Soldiers have set up security around the vehicles. You see SGT Lawrence, the motor transport section leader, in a shouting match with the Iraqi driver who had collided with the truck. They're arguing about whose fault it was and who has to pay for damages. SGT Lawrence is accusing the Iraqi of causing the accident intentionally.

The damaged vehicle is a taxi owned and driven by a local man named Walid. He occasionally comes to the base to provide transportation for base personnel. When you arrive, SGT Lawrence, who is not on duty, is out of control. He is shouting at Walid using very offensive language. Walid is responding in Arabic.

If you were in this situation, circle (1-5) how important it would be to **know what Walid is thinking?**	*Very Important* *Not Important*
	1——2——3——4——5

A dozen Iraqi soldiers from a nearby checkpoint have come over to watch. They are cheering for Walid and becoming increasingly angry at SGT Lawrence's behavior. Some of the American soldiers are shouting back. Iraqi soldiers are fanning out around the scene and some have unslung their weapons. SGT Lawrence yells at the American soldiers to stand ready and be prepared to use force.

Your priorities: *How important is each of these actions? Review all of the actions below and rank them from '1' for most important to '4' for least important. Use each number only once.*

Rank	*Actions*
	a. Order SGT Lawrence to return to the base to reduce tensions.
	b. Listen attentively to Walid so those watching will trust you to find a fair resolution.
	c. Convince the Iraqis that the problem will be resolved faster if they return to their checkpoint.
	d. Reduce immediate risk by ordering your men to take cover behind their vehicles while you talk to the crowd.

Your confidence: *If <u>you</u> were in this situation, circle how confident you would be that you could accomplish each action (1 = Very Confident, 5 = Not Confident).*

How confident would you be that you could:	*Very Confident Not Confident*
Get SGT Lawrence to return to the base.	1——2——3——4——5
Increase the trust Walid and the others have for you.	1——2——3——4——5
Get the Iraqi soldiers to peacefully return to their checkpoint.	1——2——3——4——5
Keep your men safe by having them move behind the vehicles.	1——2——3——4——5

Scenario Continues
You are able to convince SGT Lawrence to return to the base and to convince your men to take positions behind the vehicles. Meanwhile, an Iraqi police officer arrives. You both listen as Walid describes what had happened and how SGT Lawrence started shouting. Looking at the two vehicles, it is your impression that this was a genuine accident.

The Iraqi police officer demands the U.S. truck driver's Identification Document. He says this is required under Iraqi law. You explain that U.S. soldiers are not allowed to surrender their IDs. The police officer continues his request and the Iraqi soldiers are getting more agitated. They continue shouting and mocking SGT Lawrence and the other Americans. As the dispute continues, you notice traffic building up behind the accident. You fear that Iraqi citizens will begin leaving their vehicles to see what is going on.

Your priorities: *How important is each of these actions? Review all of the actions below and rank them from '1' for most important to '4' for least important. Use each number only once.*

Rank	*Actions*
	a. Take pictures of the vehicles so that Walid and the onlookers see that you are objectively documenting the damage to the car.
	b. Ask the Iraqi police officer to help you disperse the crowd and to help you prevent a traffic build-up.
	c. Direct your attention to monitoring and controlling the crowd of Iraqi soldiers because they are the immediate threat.
	d. Explain to the Iraqi police officer that your soldiers are not allowed to hand over their ID cards. Assure him that an acceptable document will be available tomorrow.

Your confidence: *If <u>you</u> were in this situation, circle how confident you would be that you could accomplish each action (1 = Very Confident, 5 = Not Confident).*

How confident would you be that you could:	*Very Confident Not Confident*
Convince Walid and the onlookers that you want to resolve the problem fairly.	1——2——3——4——5
Get the Iraqi police officer to help disperse the crowd.	1——2——3——4——5
Monitor and control the crowd of Iraqi soldiers.	1——2——3——4——5
Satisfy the police officer that he will have an acceptable document for the soldier the next day.	1——2——3——4——5

End Scenario #1: Broadsided

Scenario #2: Shots into the Crowd

Background
You are a rifle platoon commander. You've just been assigned to a Shiite town in Iraq. Earlier this year Special Forces had arrested the town's Police Chief for taking weapons from the police armory and sending them to insurgent groups. Before he was captured, the insurgency group had terrorized the local community. You have set up your base of operations at a TV station just outside of town. The first thing you do is to arrange a meeting with the town's council at the community center. You arrive with a security force that waits outside the meeting place.

If you were in this situation, circle (1-5) how important it would be to **know how the council members view Americans?**	*Very Important Not Important*
	1——2——3——4——5

At the meeting, you plan to explain how your team will provide security. You also want to learn who are the important citizens and who you can trust. You would like to avoid misunderstandings as much as possible. You include your translator to help communication at the meeting. What are the most important objectives that you want to convey to the council?

Your priorities: *How important is each of these actions? Review all of the actions below and rank them from '1' for most important to '4' for least important. Use each number only once.*

Rank	*Actions*
	a. Convince the local council that you will be able to improve security if they provide information about potential threats.
	b. Stay alert for individual council members who seem likely to become threats in the future and those who seem likely to become allies.
	c. During the meeting, focus your attention on their concerns and their hopes.
	d. Acknowledge the town's problems in the past with insurgent groups and indicate your intent to improve security and minimize threats.

Your confidence: *If <u>you</u> were in this situation, circle how confident you would be that you could accomplish each action (1 = Very Confident, 5 = Not Confident).*

How confident would you be that you could:	*Very Confident Not Confident*
Increase the council's trust and their co-operation in security matters.	1——2——3——4——5
Identify potential threats among the council members and cultivate potential allies.	1——2——3——4——5
Encourage the council to convey their wants and needs so that you can incorporate them into your planning.	1——2——3——4——5
Keep tensions low by explaining your future intensions to increase security.	1——2——3——4——5

Scenario Continues:
The meeting lasts several hours. You try to answer their questions as honestly and directly as possible. There are no major problems but several council members appear to be uneasy and seem skeptical about you and your motivations.

The meeting has ended satisfactorily and you walk away from the table with your translator. As you leave the community center you first notice that the villagers have gathered to greet you and you then hear gunfire. You immediately assume the worst—an attack on your security force waiting outside the building. Suddenly one of your men yells, "Sir, it was me, I fired in error!" You see that a 10-year-old and two teenagers have been shot. Understandably, the villagers are reacting with agitation and screaming. You need to act quickly to avert harm and identify your best course of action.

Your priorities: *How important is each of these actions? Review all of the actions below and rank them from '1' for most important to '4' for least important. Use each number only once.*

Rank	*Action*
	a. Direct your platoon to an exterior defense posture in case there is retaliation.
	b. Inform the villagers that your medics will provide first aid, and assess the injuries to determine what additional treatment will be needed.
	c. Order your men to lower their weapons to acknowledge your responsibility and as a sign of respect for the injured children.
	d. Ask the crowd to clear the immediate area to make it easier for your medics to initiate diagnoses and medical care.

II. Complex Scenarios: #2 Shots into the Crowd

Your confidence: *If you were in this situation, circle how confident you would be that you could accomplish each action (1 = Very Confident, 5 = Not Confident).*

How confident would you be that you could:	*Very Confident Not Confident*
Take the necessary security precautions in case of an attack.	1——2——3——4——5
Provide assurance to the villagers.	1——2——3——4——5
Reduce hostility and cultivate a sense of common concern.	1——2——3——4——5
Persuade the crowd to clear the area.	1——2——3——4——5

You immediately announce your responsibility and order your medics to provide medical attention. This quiets the gathered crowd. The teenagers' wounds seem to be minor. They are treated on site by your medics. However, the 10-year-old is injured pretty badly. He and his parents are taken to a larger medical facility several miles away for further evaluation and treatment.

Scenario Continues:
The next day you are faced with a difficult decision. Before the accident happened, you had scheduled another meeting with the town leaders. You need to maintain a constructive relationship with the town in order to accomplish your mission but you also want to limit risk. How should you approach this follow-up meeting?

Your priorities: *How important is each of these actions? Review all of the actions below and rank them from '1' for most important to '4' for least important. Use each number only once.*

Rank	*Actions*
	a. Begin the meeting by reporting the medical condition of the child. Indicate that he will continue to receive needed medical care.
	b. To cultivate good will and a shared concern, go to the meeting with limited security and armor. Walk into the meeting room without your Kevlar and helmet.
	c. Because of the civilian injuries your team caused, go to the meeting with increased security (more troops) in case of hostility or retaliation.
	d. Explain that their immediate cooperation in clearing the way for the emergency vehicles helped get the child to medical care. This begins a cooperative relationship.

Your confidence: *If you were in this situation, circle how confident you would be that you could accomplish each action (1 = Very Confident, 5 = Not Confident).*

How confident would you be that you could:	*Very Confident Not Confident*
Reduce the councils' anger by reporting on the child's condition.	1——2——3——4——5
Reduce hostilities by going to the meeting with limited security and minimal armor.	1——2——3——4——5
Maintaining security by taking protective safety measures to reduce the chances of an attack.	1——2——3——4——5
Increase community cooperation in the future by pointing out its role after the shooting.	1——2——3——4——5

End Scenario #2: Shots into the Crowd

Scenario #3: Guard Tower

Background
You are part of a multinational team assigned to maintain security in a remote area of Iraq. Your job is to oversee the guard tower forces that maintain security operations around the perimeter and entrances to the base. You have about 14 skilled U.S. troops as well as about 40 Iraqi nationals. With the exception of your assigned translators, few of the U.S. personnel know more than basic Arabic. The Iraqis have had no English language instructions but some of them are picking up language by listening to the banter of their American counterparts.

While security is your most important duty, your base commander has also emphasized the importance of building the skill levels of the Iraqi forces. The hope is that when U.S. troops withdraw, they will leave behind an effective local workforce and a secure region. He also believes that creating good working relationships with local people is critical for the immediate security and safety of the U.S. troops.

You are called in when conflicts arise between the U.S. and Iraqi soldiers. Lately you've received several complaints about an Iraqi worker who has been harassing one of the U.S. soldiers.

If you were in this situation, circle (1-5) how important it would be to **know what is bothering the Iraqi worker?**	*Very Important* *Not Important* 1——2——3——4——5

While the Iraqi knows little English, he has been using deeply offensive language to describe the mother of one of the U.S. soldiers. For the U.S. soldier, this insult couldn't be ignored. What began as a shouting match between the two men became physical with both men throwing punches. The two men were separated and ordered to report to your office where an interpreter will be available. They were also temporarily removed from their shift. What are your priorities in handling this situation?

Your priorities: *How important is each of these actions? Review all of the actions below and rank them from '1' for most important to '4' for least important. Use each number only once.*

Rank	*Actions*
	a. With both men removed from their shifts, you need to make sure that there are replacements available at their posts.
	b. Take a position between the two men in order to lower tensions and the possibility of additional fighting.
	c. Tell the men that you know that it is difficult to work together with no shared language and you believe your translator may help resolve the problem.
	d. Explain that their conflict cannot continue. Tell them you need their help to settle the conflict so that you don't have to make an official report.

Your confidence: *If <u>you</u> were in this situation, circle how confident you would be that you could accomplish each action (1 = Very Confident, 5 = Not Confident).*

How confident would you be that you could:	*Very Confident Not Confident*
Maintain security during this disturbance.	1——2——3——4——5
Lower tensions and additional aggression.	1——2——3——4——5
Build a positive relationship between the two soldiers.	1——2——3——4——5
Get the combatants to cooperate with you.	1——2——3——4——5

Both the American and Iraqi are hesitant to talk, but eventually you find out the whole story. It turns out that the Iraqi soldier speaks little English. In his effort to learn English, he had picked up an English phrase that U.S. soldiers sometimes use jokingly with each other. He did not know that it was an insult that could not be tolerated coming from an outsider. It's good that you solved this problem because it could have interfered with your base's security or developed into something bigger.

Scenario Continues
The next evening, you are faced with another very different problem. An Iraqi in one of the guard towers sounded the alarm to report movement near the base perimeter. The Iraqis are often "spooked", and sound the alarm even when there isn't a real threat. Not only is this stressful, it also reduces the urgency of legitimate alarms. This has become a recurring and potentially dangerous situation.

You've tried to explain that alarms should be sounded only in case of an enemy sighting. However, this afternoon an Iraqi signaled an alarm when he saw a shepherd herding goats too close to the perimeter. You had hoped the guards could distinguish between an innocent villager searching for a stray goat and an insurgent planting an IED. Maybe he only saw movement and felt it was important to respond as quickly as possible. Maybe he wanted his superiors to know that he was able to spot every sign of trouble. This problem is very frustrating, often a waste of time, and potentially dangerous. Given this background, how should you handle this particular false alarm and the problem of false alarms overall?

Your priorities: *How important is each of these actions? Review all of the actions below and rank them from '1' for most important to '4' for least important. Use each number only once.*

Rank	*Actions*
	a. Continue the standard protocol and treat every alarm as a real threat. Request that this soldier be replaced with someone capable of judging danger.
	b. Tell the Iraqi soldier you value that he is working hard to keep the base safe. Require that he re-take his training so that he can keep his job and make better risk assessments in the future.
	c. Tell the Iraqi soldier that you know their task can be difficult. Express your appreciation for his work and explain that you have hopes for improvements.
	d. Have his Iraqi supervisor work with him to moderate his tendency to overreact to non-critical events.

Your confidence: *If <u>you</u> were in this situation, circle how confident you would be that you could accomplish each action (1 = Very Confident, 5 = Not Confident).*

How confident would you be that you could:	*Very Confident Not Confident*
Maintain effective security while allowing soldiers to treat every alarm as a real threat.	1——2——3——4——5
Have the soldier reach acceptable reporting standards by telling him you respect his effort but that he must repeat the training.	1——2——3——4——5
Have the soldier reach acceptable reporting standards by expressing your appreciation for the soldier's work and hoping his work improves.	1——2——3——4——5
Reduce the Iraqi soldiers tendency to overact using the Iraqi supervisors help.	1——2——3——4——5

End Scenario #3: Guard Tower

Scenario #4: Disaster Relief In The Philippines

Background
The U.S. Pacific Command sent a task force to assist in relief efforts following a flood in the Philippines. The storm killed hundreds of people and also destroyed roads, schools, and other infrastructure. The immediate impact created a serious food and water shortage causing dangerous conditions for epidemics. U.S. fixed-wing and tilt-rotor aircrafts were sent in to provide crucial access to the remote and inaccessible area.

As supplies arrive by air, people stream towards hastily set up distribution centers. You are the Staff Sergeant in charge of the food distribution for one village. People are waiting their turn even though it is taking several hours to get to the front of the line.

As the day progresses, the lines grow longer. You notice agitation at the back of the line. You take three soldiers and a translator and go to the disturbance. You see that men from a neighboring community, armed with short swords, are threatening the local villagers. The local villagers, understandably terrified, are dropping their supplies and running.

If you were in this situation, circle (1-5) how important it would be to **know what the looters are really thinking?**	*Very Important* *Not Important* 1——2——3——4——5

The looters may be taking supplies because their own village has not yet received help. People will often go to great effort to care for their families and their friends. On the other hand, they may be using this crisis to settle long-standing disagreements or to acquire new territory and objects of value.

Your priorities: *How important is each of these actions? Review all of the actions below and rank them from '1' for most important to '4' for least important. Use each number only once.*

Rank	*Actions*
	a. Attempt to identify the reason(s) for their behavior so you can find a solution.
	b. Give the looters a way out with the help of your translator: "this situation hasn't gotten out of control, yet. Leave now and you will not be harmed."
	c. Explain, with the help of your translator, that you would like to find a solution but that first they must return all of their weapons to their village or leave them with you.
	d. Prepare to fire non-lethal shots at the men wielding the swords, as they have potentially deadly weapons and you cannot risk innocent lives.

Your confidence: *If <u>you</u> were in this situation, circle how confident you would be that you could accomplish each action (1 = Very Confident, 5 = Not Confident).*

How confident would you be that you could:	*Very Confident Not Confident*
Identify the looter's motivations to create a solution.	1——2——3——4——5
Get the looters to leave immediately by letting them know that if they do, they will not be harmed.	1——2——3——4——5
Have the looters return their weapons or leave them with you in exchange for the chance of negotiating a compromise.	1——2——3——4——5
Secure the area using force.	1——2——3——4——5

Scenario Continues:
You were able to solve the looter problem and the relief effort is now going smoothly. The following week, however, you receive a report from mission headquarters that samples of water from the local wells showed signs of contamination. You are ordered to seal the wells and carry out a NEO (non-combatant evacuation operation) moving the villagers to a relocation center set up about 12 miles away.

The trucks are to arrive in the morning and you issue emergency water to all villagers for use during the relocation. Some residents become upset and protest. They are afraid that the looters will return to steal and to destroy their village. They love their homes and don't want to leave them even briefly. How might you best accomplish the evacuation with the help of your translator?

Your priorities: *How important is each of these actions? Review all of the actions below and rank them from '1' for most important to '4' for least important. Use each number only once.*

Rank	*Actions*
	a. Talk with the villagers to assure them you are taking steps to keep their village safe.
	b. Tell the villagers that the bad water can sicken children. Tell them that you have a young son and know how much they must want to keep their children safe.
	c. When the trucks arrive, assign families to the trucks. If people resist, use the local leaders to insure every person is on a truck. Use force if necessary.
	d. Help them understand the danger by comparing the color of clean water with water from their well. Show pictures of the harmful effects of contaminated or 'dirty' water.

Your confidence: *If you were in this situation, circle how confident you would be that you could accomplish each action (1 = Very Confident, 5 = Not Confident).*

How confident would you be that you could:	*Very Confident Not Confident*
Calm the villagers by explaining the safeguards you have in place.	1——2——3——4——5
Gain acceptance of the evacuation by explaining that you, like them, are concerned about the well being of their children.	1——2——3——4——5
Use local enforcement leaders to move people into trucks to complete your assignment.	1——2——3——4——5
Convince the residents that the water is unclean.	1——2——3——4——5

End Scenario #4: Disaster Relief

Scenario #5: Bosnian Weapons Harvest (Peacekeeping)

Background
Bosnia had experienced heavy damage during earlier and long-standing conflicts. Many people still have firearms in their homes. To create a safer community, the U.S. military designed a two-phase weapons collection program. During Phase 1, the U.S. team opened a local drop-off site where people could dispose of weapons and meet the U.S. peacekeepers. For Phase 2, every household received a pamphlet in the mail announcing door-to-door visits to make it easier for people to dispose of weapons. The pamphlets stressed that the safety was the main concern and it encouraged people to give up their weapons.

You are leading one of the weapons collection teams visiting homes and encouraging people to dispose of weapons. You approach each home with two soldiers and a local translator. Many people say they do not have any firearms but most visits are friendly. At one home, however, an agitated man opens the door. Your translator asks him if he has any weapons he'd like to give to your team. The man becomes very hostile and says that he has to leave for work immediately. You ask if he has weapons where he works and suggest that he might also dispose of these. The man ignores the question, walks into his house and emerges carrying work tools.

If you were in this situation, circle (1-5) how important it would be to **understand what is troubling the man?**	*Very Important* *Not Important* 1——2——3——4——5

Your priorities: *How important is each of these actions? Review all of the actions below and rank them from '1' for most important to '4' for least important. Use each number only once.*

Rank	*Actions*
	a. Make conciliatory gestures to put the man at ease. Tell him that he is not required to give up his weapons but that your job is to help him do so if he is interested.
	b. Record the location of the man's home to keep an eye out for potential threats. After this, move on to the next house.
	c. Point out a child's bike in the yard and have your translator explain the potential danger of a weapon to neighborhood children.
	d. Have your team to return to your vehicle. Have your translator explain to the man that you are not there to cause trouble but to help make his community safer.

Your confidence: *If <u>you</u> were in this situation, circle how confident you would be that you could accomplish each action (1 = Very Confident, 5 = Not Confident).*

How confident would you be that you could:	*Very Confident Not Confident*
Make a conciliatory gesture that would put the man at ease.	1——2——3——4——5
Use the situation to increase your attention to potential neighborhood problems.	1——2——3——4——5
Persuade the man to surrender his weapons voluntarily for the sake of neighborhood children.	1——2——3——4——5
Have your translator, a local person, speak with the man to help him see the danger.	1——2——3——4——5

Scenario Continues:
As you continue around the village, a boy comes out of his home and unexpectedly approaches you with a grenade in his hand. You look at it and use gestures to explain to the boy exactly how he should hand the object to one of your soldiers. The boy follows this request and places the grenade as directed. The soldier locates a place behind a brick wall that is a safe distance away. You then get on your radio and report your position and the condition of the grenade. You are told that the EOD (Explosive Ordnance Disposal) team will arrive on scene to help ASAP. You must wait for EOD to arrive. You are uncertain when they will come so you move to a safe location. Many children and adults notice your presence in the village and begin to approach you. They are curious why you stopped. What do you do?

Your priorities: *How important is each of these actions? Review all of the actions below and rank them from '1' for most important to '4' for least important. Use each number only once*

Rank	*Actions*
	a. Respond calmly to the gathered people to gain co-operation. Assure those in the area that steps for safe removal of the grenade have been initiated.
	b. The grenade is a high threat to your team and the villagers. Have your team cordon off the area around the grenade in order to ensure safety for your team and villagers.
	c. As long as you must wait, chat with the adults who have gathered. If kids in the village play soccer, challenge them to a friendly game at a safe distance from the grenade.
	d. Use this grenade incident to express the dangers of having weapons in homes. Explain to the villagers that you can dispose of weapons safely if they bring them to you.

Your confidence: *If <u>you</u> were in this situation, circle how confident you would be that you could accomplish each action (1 = Very Confident, 5 = Not Confident).*

How confident would you be that you could:	*Very Confident Not Confident*
Provide reassurance to the citizens and maintain calm behavior in the area.	1——2——3——4——5
Cordon off the area to keep your team and the villagers safe.	1——2——3——4——5
Use the opportunity to build good relationships by initiating recreational activity with the children and/or chatting with adults.	1——2——3——4——5
Use this dangerous situation to convince the people to hand over their weapons.	1——2——3——4——5

End Scenario #5: Bosnian Weapons Harvest

Please wait for directions to begin the next section.

III. Accomplishing Goals

During overseas deployments, soldiers may interact with people from different cultures. In this final section you will see situations from the earlier scenarios. For each situation, mark the good response(s) with a checkmark (✓) and mark the bad response(s) with an (X). For each question, use ✓ or X as many times as needed.

I. *In **Broadsided,** an Iraqi taxi was in an accident with an Army truck. Iraqis began gathering and shouting at the U.S. soldiers in a busy traffic circle.*

1) How could you learn the cause of the Iraqi crowd's reaction?

___ Ask people in the crowd about the accident.
___ Think about how you would react if your car had been damaged.
___ Review your past experiences with Iraqis and look for similar examples.
___ Ask the U.S. soldiers on site why the crowd reacted as it did.

2) What are effective ways to calm down the crowd?

___ Address the crowd quickly before tensions rise.
___ Raise your voice and order the crowd to calm down.
___ Isolate SGT Lawrence so he can't increase tension.
___ Raise your weapons so they are visible to the crowd.

3) How might you build a good relationship with Walid?

___ Promise him that he will receive money, even though he might not.
___ Tell Walid that you understand his frustrations about his taxi.
___ Tell him that intentional crashes are common so he may be in trouble.
___ Tell Walid "we're both better off if this is solved quickly."

4) How might you enlist Walid to help reduce the tension?

___ Tell Walid that you will help him but he needs to help calm the crowd.
___ Explain that when things settle down, you'll help him file for damages.
___ Tell Walid that if he doesn't cooperate, his taxi services will no longer be welcomed on the base.
___ Control the situation by repeat your position until he understands and yields.

II. *In the **Shots into the Crowd** incident, after an initial meeting with the town council you experienced major problems.*

1) How could you build a good relationship with the council?

___ Ask the council leaders about their city's needs and refer to these during the meeting.
___ Explain how much they could learn from the U.S.'s success.
___ Tell the council about your priority for the safety of your men.
___ Explain why you and your team are there and how you plan to help them.

2) How would you figure out what the council members are most concerned about?

___ Compare this situation to similar situations in your past.
___ Ask the Iraqi council members for their thoughts and opinions directly.
___ Think about the concerns you would have living in this town.
___ Talk with soldiers who have worked successfully with Iraqis in the past.

3) After the council meeting, three children were shot by your team. What would be appropriate ways to calm this situation?

___ Leave the situation immediately as your presence may add to the tension.
___ Arrange for the injured child to be medevac'd to a hospital quickly.
___ Have your troops keep a security posture. If approached tell people to back off – no exceptions.
___ Lower your weapons to reduce hostilities.

4) After the shootings, how would you convince people to help manage the situation?

___ Ask that they give your team space to provide immediate medical care.
___ Strengthen your security posture and order the town people to leave the area.
___ Describe how the people shared responsibility by making your soldiers nervous.
___ Ask people living near to bring water and supplies to help the children.

III. *Think back to the* ***Disaster Relief*** *scenario when contaminated water meant you had to move the people to temporary shelters. Some villagers were afraid and refused to go. They feared that their aggressive neighbors would return and destroy their village.*

1) How would you convince the villagers to move?

___ Remind them of the good treatment they have received.
___ Order them onto the trucks using force if necessary.
___ Tell them you won't defend the village unless they leave.
___ Explain the danger posed by the water and the protection provided to their homes.

2) During the relocation one villager demands to be returned home. What's the best way to calm the situation?

___ Speak with the villager and subtly suggest that the delay he is causing may expose the rest of the villagers to danger.
___ Subdue the villagers demands by threating him.
___ Announce to the rest of villagers that he is endangering everyone's safety.
___ Move him out of view of the others and talk quietly with him.

IV. *Think back to the* ***Bosnian Weapons Harvest*** *scenario.*

2) How would you figure why the man was hostile when you knocked at his door?

___ Talk with the man at a more relaxed time.
___ People are often agitated when they're frightened so this is the likely cause.
___ Ask your translator, who is native to the area, why he thinks the man is agitated.
___ Think about how you would react in this situation.

3) How would you build relationships with the Bosnians while you wait for EOD to take care of the grenade?

___ Suggest a soccer game with the young people to build trust.
___ Tell the crowd that the problem stems from the presence of weapons in homes
___ Ask the adults about their community and accept offers for tea while you wait.
___ Stay apart from the villagers to respect their privacy.

Please continue to the Demographic Information section on the next page.

Demographic Information

1. Your current rank?					
Number of Years:	0-2	3-5	6-10	10-15	16+
2. Years of service at current rank	☐	☐	☐	☐	☐
3. Years of total active duty service	☐	☐	☐	☐	☐
4. Have you had intercultural training? *If so, please describe:*	☐ Yes ☐ No _____				
5. Sex:	☐ Male ☐Female				
6. Age:	17-20 ☐	21-24 ☐	25-28 ☐	29-34 ☐	35+ ☐
7. Years of post high school education:					
8. Longest Held Civilian Job:					
Position Title & Duration (months):					
10. Languages	*First*:			*Second*:	

Please list below the places you have been deployed and the total number of months you were deployed there.

Number of Months:	0-6	7-12	13-18	19-24	25+
Iraq	☐	☐	☐	☐	☐
Afghanistan	☐	☐	☐	☐	☐
East/Southeast Asia	☐	☐	☐	☐	☐
Central/South America	☐	☐	☐	☐	☐
Other: _____	☐	☐	☐	☐	☐
Other: _____	☐	☐	☐	☐	☐
Other: _____	☐	☐	☐	☐	☐

Please continue to the Final Consent & Authorization Section on the next page.

Final Consent & Authorization

Do you authorize MacroCognition LLC to compile and analyze the responses you've provided in this Gap Study packet?

□ YES

□ NO

(Please check one box)

We thank you for your participation. We hope that the information you have provided will help future members of the U.S. military work more effectively and safely. If you have any questions or concerns, please let us know. If you can't contact us before we leave, our contact information is on the debriefing form.

- The MacroCognition Research Team

Summary of Gap Study data collection activity at Fort Benning

Date: 3 July 2014

Researchers: Helen Altman Klein (MacroCognition LLC), Joseph Borders (MacroCognition LLC) & Scott Flanagan (Sophia Speira)

Overview: MacroCognition LLC conducted data collection for the Gap Study on 3 July 2014 at Fort Benning, Georgia. Over 160 Non Commissioned Officers enrolled in the Henry Caro NCO Academy (Leader Development) completed this summative, three part study.

The Gap Study contains scenario driven data collection methods developed in TA1B, as well as more standard survey and interview-based methodologies. This study is designed to identify the cognitive, behavioral, and perceptual gaps between the Good Stranger (GS) skills needed and those possessed by participants. The present work supports Raytheon BBN Technologies current effort in developing a social training simulator. First, it will provide a **Frame Assessment (*Brief Scenarios*)**: to diagnose the prominence of four cognitive frames or mental models – Good Stranger, Mission, Rules & Procedures, and Authority/Domineering. We hope to validate this cost effective tool as an effective option for identifying the personnel who would benefit most from the BBN simulator. Second, this research will provide a **Learning Objectives Assessment (*Complex Scenarios*)**: to diagnose decision priorities in complex military situations. This section provides participants' preference and confidence in performing actions related to Learning Objectives we've identified as most conducive to the GS mindset – de-escalation, voluntary compliance, building rapport, perspective-taking, and security. Lastly, we will employ a final **Ability Assessment (*Accomplishing Goals*)**: examines how accurately participants understand the behaviors that support the learning strategies they encountered in the previous section. These three profiles can guide trainee selection and individualize training to best support the development of social interaction skills and human dynamics proficiencies for future trainees.

Schedule: We collected data with 161 Non-Commissioned soldiers enrolled in the Henry Caro Academy (Infantry Senior Leader Course) on 3 July 2014 from 0700 – 0840.
0700 – 0715 Greetings, Introduction, Consent From (Helen Altman Klein)
0715 – 0730 Frames (Brief Scenarios)
0730 – 0810 Learning Objectives (Complex Scenarios)
0815 – 0825 Ability (Accomplishing Goals)
0825 – 0840 SSIM Briefing, Thank You (Scott Flanagan)

Location: USARMY, Fort Benning, GA – NCOA Infantry Senior Leader Course
Building # 224, Room # 132

Sponsor: Funding for this project was provided by the SSIM (Strategic Social Interaction Modules) program within DARPA (Defense Advanced Research Projects Agency) BAA-11-32 Technical Area 2.

SSIM goal: In addition to collecting data for the Gap Study, the topic of the scenarios involved approaching civilians with respect and attempting to build trust, as opposed to trying to gain

compliance through coercion and intimidation which might work in the short-term but appears to generate anger and a desire for retaliation in the long-term.

Data collection plan: Our plan was to run 120 enlisted Army soldiers (a mixture of E-5 – E7). MacroCognition LLC provided soldiers with a consent form upon their arrival. At this time, the soldiers were made aware of their rights as research participants, and they could opt to not sign the consent form without any consequence. Next, consenting participants completed the Gap Study as MacroCognition LLC personnel facilitated instructions. After the completion of the study, Scott Flanagan (Sophia Speira) briefed the participants on the SSIM initiative and the Gap Study. Participants were thanked and given a debriefing form with similar information. The study was completed by 0900.

Process outcome: We were successful in collecting all the data we needed. In fact, we surpassed our expected goal of 120 participants. We appreciate all of the support we received at Fort Benning. We now are beginning the analysis of the data, which will take many weeks, but we wanted to use this memorandum to describe our project and to express our gratitude.

Informal Evaluation: Although we are just starting to sort through the data, we are beginning to see trends emerge, particularly in the Frames Assessment (10 brief, scenario-based, ranked choice questions). We are starting to see that across the (10) scenarios, individuals prefer different frames (e.g. GS orientation, Mission orientation). Also, our preliminary data shows that scenarios may impact participants' preferred frame as well. For instance, riskier scenarios may cause participant's to take on a Rules & Procedure or Authoritarian orientation, rather than a GS frame. We plan to continue these analyses and further explore how the population varies in prioritizing our Learning Objectives and how they vary in self-efficacy (confidence). Furthermore, we can analyze and compare prioritizing, perceived capability and actual ability/understanding of the Learning Objectives. As we continue to analyze our data, we will distribute our findings to Fort Benning, BBN and the SSIM team.

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Good Stranger Diagnostic Tool: Measuring Capacities and Limitations to Inform Training

Helen Altman KLEIN[a] and Joseph BORDERS[a]
[a]*MacroCognition LLC*

ABSTRACT

US military personnel encountering civilians can function as "Good Strangers" (GS), cultivating co-operation and safety, or they can act in ways that increase hostility. Current work investigates the dynamics of social interactions and training technologies attempting to increase positive outcomes of military social encounters. Soldiers at Ft. Benning completed the GS Diagnostic Tool measuring the GS cognitive frame and its strategic, behavioral and affect components. First, we examined differences between a GS frame and other cognitive frames: Mission, Rules/Procedures, and Authority. We then investigated priorities for tactics and skills: Perspective Taking, De-escalation, Building Rapport, Voluntary Compliance, and Security. Finally, we assessed confidence and competence levels for the tactics listed above. We found differences among warfighters as well as significant relationships among frame preference, response tendencies, and competencies. The research suggests how social interaction training might be most effective when addressing gaps between initial capacities of the learner and GS essentials.

KEYWORDS

Decision Making, Military, Macrocognition, Adaptive Learning, Counter Insurgency

INTRODUCTION

Ongoing advances in computer-based instructional technology have revolutionized the approaches we can use to deliver training. These advances have increased the effectiveness of training and dramatically reduced the time needed to achieve positive outcomes. They have also facilitated training for more complex cognitive capacities, such as cultural awareness and social competencies (Raybourn, 2005). One reason for this is that adaptive instruction can individualize training by adjusting to the learner's initial state and by continually accommodating increments in their knowledge/skill. Learners can receive a stream of feedback about their performance to enhance their decision making capabilities and improve their understanding. This purpose of this paper is to introduce the Good Stranger Diagnostic Tool, a cognitive and social competence assessment tool as a prototype to support advances in adaptive learning and training in the military sector.

Good Stranger Project

This work was undertaken as part of MacroCognition LLC's involvement in the Defense Advanced Research Projects Agency (DARPA) Strategic Social Interactions Module (SSIM) program. This program was designed to investigate the dynamics of maintaining a *Good Stranger* (GS) cognitive frame during military and civilian encounters. Because of the unique demands facing military personnel during foreign deployments, we needed to go beyond the expansive literature on "soft" methods of persuasion and influence (e.g., Cialdini, 1993; Thompson & Jenkins, 1993/2004; Glennon, 2010; Wilson, 2011; Thaler & Sunstein, 2008). For this reason, we conducted Cognitive Task Analysis (CTA) interviews with over forty military and police personnel to better understand what basic skills are needed to foster constructive social encounters, regardless of language and cultural barriers, in high-risk environments. We include police personnel because they face some of the same challenges as warfighters. In the process, we formulated an empirical model (see Figure 1) centered on the process of building trust (G. Klein, H. A. Klein, Lande, Borders & Whitacre, 2014b). We identified behavioral and cognitive strategies that were strong predictors of building trust and conducive to being a Good Stranger, namely building rapport, de-escalating, perspective taking, and preferring voluntary compliance. These strategies are behavioral extensions of the Good Stranger Cognitive Frame.

Our CTA interviews with police officers and military personnel also identified substantial individual differences in preferences for taking the perspective of others, building rapport, and de-escalate conflicts (G. Klein, H. A. Klein, Lande, Borders & Whitacre, 2014a). The GS strategies are not, of course, rule-based or procedural, but depended on cognition – making sense of complex situation and creating solutions dependent on the situation. The interviewees also seemed to differ in their skill in implementing these strategies. Interviewees who showed greater skill in implementing these strategies were more likely to build trust with civilians and community leaders. These cognitive skills and the receptivity to new ideas are basic to the Good Stranger cognitive frame. Some interviewees appeared more equipped to build trust with civilians and community leaders while others did

not use this cognitive frame when sizing up situations. This variability makes a standardized program of instruction difficult.

Cognitive Frames

Instead of trust building, perceptions and behaviors may be driven by other underlying goals. Using the data/frame model of sensemaking (G. Klein, Moon & Hoffman, 2006a, 2006b), we examined how military and police personnel varied in the way they made sense of situations. Based on our CTA interviews, we hypothesize that respondents will vary in the frames they use to make sense of situations. Depending on their frame preference, warfighters will notice different cues, form different expectancies, generate different goals and consider differing courses of action (see Figure 1). In doing this, we identified three prominent cognitive frames in addition to the GS frame that military personnel use to make sense of situations: Rules and Procedures, Mission and Authority.

Rules and Procedures Frame

The military as an organization has a well-defined hierarchical leadership and centralized decision making that promotes structured thinking. Warfighters are trained to adhere to rules and procedures and rely on these guidelines in times of uncertainty. Rules and Procedures orient warfighters to follow protocol and avoid deviating from these rules as their highest priority. In combat, rules and procedures are critical, as they maintain safety and security. This frame can be used in co-ordination with other frames, like the Mission frame. Warfighters can closely proposed guidelines while working towards mission completion.

Mission Frame

Some warfighters see the mission as the driving force behind decisions and actions. They do not rely as heavily on a Good Stranger or Rules and Procedures frame to gauge situations. Instead, they rely on creativity and strategic thinking in an attempt to optimize mission completion. The Mission-oriented approach can also use other frames to make sense of the situation and act in an effective manner while promoting mission completion.

Authority Frame

Security is an essential component of the warfighter's worldview. However, some high security-minded individuals may exaggerate this approach and become domineering. These warfighters use their authority and power to gain compliance from others and they do not hesitate to use coercion. They also tend to escalate situations because they take provocations personally. The Authority frame can promote resentment and distrust among community members, and sometimes yields unfavorable long-term consequences for military and police forces.

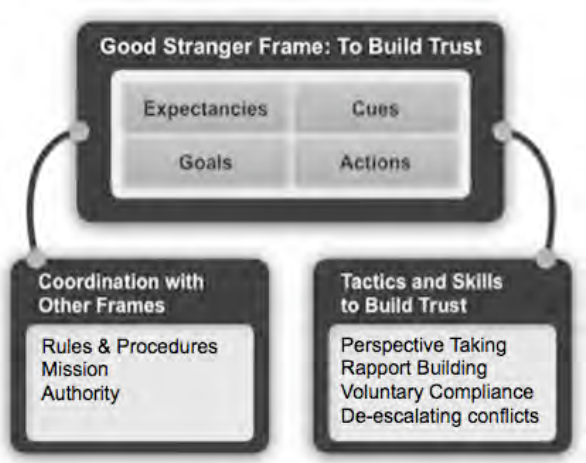

Figure 1. The Good Stranger Frame: To Building Trust

These frames are not mutually exclusive and situational demands influence the frame being used. Kinetic encounters involving hostile enemies demand an Authority frame or a Rules and Procedure frame. For example, the cues, goals, expectancies and actions differ when needing to protect one's life or the life of others than when wanting to gain trust with community leaders and/or civilians. We expect that all participants will be concerned with self-protection and most will use a Mission and/or a Rules and Procedure frame. Some will have some or most elements of a GS frame. Participants with GS frames will differ from the others in the way they appreciate means of gaining voluntary compliance, the way they engage in perspective taking, and the way they react to cultural differences – being more sympathetic, curious, and adaptable as opposed to being judgmental and ethnocentric.

The Good Stranger Diagnostic Tool

Our earlier interviews sugggested that a scenario-based diagnostic assessment will be able to support training in many ways. First, it will identify participants with the potential to become GSs. This tool will also allow us to identify the cognitive and behavioral "gaps" between the participant and the GS frame. These gaps will then become the basis for individualizing training. The tool will also allow the assessment of the knowledge of tactics and skills needed for effective social interaction skills – perspective taking, rapport building, voluntary compliance and de-escalating needed to increase trust during social interactions (see Table 2). It will also allow the identification of critical tactics and skills that are needed for a specific soldier's training. Finally, the tool will allow the assessment of the confidence needed to impliment these tactics and skills. All of this information could be continually updated during training. From the learners perspective, they will always be moving forward to new and needed content.

On the other end, we would be able to identify those people whose existing cognitve frame and behavioral patterns are simply too difficult, costly, or even impossible to alter (e.g. extremely authoritarian). The Good Stranger Diagnostic Tool was designed as a cost effective tool for identifying the personnel who would benefit most from training, particularly training that is resource intensive. These profiles can guide trainee selection to best support the development of social interaction skills and human dynamics proficiencies for future trainees. The Good Stranger Diagnostic Tool depends on several elements. First, we must be able to assess the presence of a GS Frame and the understanding of the GS tactics and skills. We must also be able to assess if the learner knows how and when to implement these skills, rather than taking a security approach. Finally, we need to know if the learner has the confideence to implement the skills when needed. This research was an initial attempt to assess the likelihood of satisfying these requirements.

METHOD

Participants

We collected data from non-commissioned Army soldiers enrolled in the Henry Caro Academy (Infantry Senior Leader Course) at Ft. Benning, GA (N = 78). All Soldiers were male, ranked E 6 – Staff Sergeant (66%) or E 7 – Sergeant First Class (34%), and had at least one overseas deployment.

Participants reviewed the consent form and research personnel explained their rights as research participants as defined by the Institutional Review Board (IRB). Next, participants individually completed the three-part GS Diagnostic tool (described in full below), as research personnel facilitated each section. Upon completion, participants received a debriefing form and short briefing explaining the SSIM initiative and the purpose of the GS Diagnostic Tool. The described procedures were in accordance with both MacroCognition's IRB procedures and those of the US Army Human Research Protection Office (HRPO).

Research Measures

Cognitive Frames Assessment

Participants read ten brief military-based scenarios and responded to prompts by ranking alternatives (1 = most important, 4 = least important). For each question, participants could only indicate one option as their (1) most important, and so on. This assessment examined the prominence of four cognitive frames (see Table 1). Each response option manifested one of the four cognitive frames.

Table 1

Cognitive Frame Types and Descriptions

Good Stranger	Tries to gain trust; understands long term consequences of action
Mission	Makes decisions that optimize mission completion
Rules and Procedure	Tries to follow protocol and avoid deviating from rules
Authority	Uses authority to gain compliance; does not hesitate to use coercion

Tactics and skills

The next section presented five complex military-based scenarios, with multiple decision points interspersed througout each scenario. This section required participants to rank response priorities and confidence levels in performing actions related to tactics and skills we've identified as most conducive to the GS mindset – Perspective Taking, De-escalation, Building Rapport, Voluntary Compliance. We also included Security, because this approach is critical for warfighters, and cannot be ignored (see Table 2). At each decision point, participants were required to rank order (1 = most important, 4 = least important) four of the tactics and skills (De-escalation, Building Rapport, Voluntary Compliance and Security). Participants could only idicate one of the options as their (1) most important. Perspective Taking was assessed at each decision point using a separate Likert Scale because this tactic is more cognitive based and was not easily comparible to the other skills listed. Next, particpants indicated their confidence for each of the four tactics (excluding Perspective Taking) and skills using a Likert Scale (1 = very confident, 5 = not confident at all).

Table 2

Learning Objectives and Descriptions	
Perspective Taking	Sees the world from other's perspectives and uses this to understand the actions of others
De-escalation	Reduces the intensity of situations or conflicts; remains calm and helps others to move towards calm
Building Rapport	Works to develop a positive relationships with others to accomplish tasks
Voluntary Compliance	Seeks voluntary rather than coercive compliance by understanding others and using socials skills
Security	Considers security as most importance when assessing situational demands

Ability Assessment

The last section examined how accurately soldiers understood the behaviors that supported the skills and tactics they encountered in the previous section (see Table 2). For example, to assess de-escalation, participants were asked to reflect on an earlier scenario and indicate the effective and ineffective ways to accomplish the goals (for example, calm down a crowd). Soldiers indicated their judgment of effective and ineffective strategies for achieving goals by selecting from two optimal and two incorrect choices. Each question was followed by a list of four alternatives. Based on a participant's percent correct, they were assigned an overall Ability score which indicates their competency for the skills and tactics listed in Table 2.

RESULTS

Baseline Assessment – Cognitive Frame Preference

Our inital objective was to examine this sample's frame preferences, as a whole. To generate a basic frame preference outlook, we combined individual frame rankings across each of the ten frame questions. Using these overall frame preference scores, we calculated group averages for each cognitve frame. The highest possible score was 40. Good Stranger was the most preferred frame type (M = 29.22, SD = 3.71) across all ten scenarios, followed closely by Rules & Procedures (M = 28.58, SD = 3.71). The Mission frame was ranked lower (M = 25.19, SD = 3.03) and Authoritarian was the least preferred frame type overall (M = 17.03, SD = 3.91).

Frame Type Predicts Response Tendencies

Next, we looked for relationships of frame preferences and prioritization of tactics and skills, confidence levels and Ability scores for the tactics. Are response tendencies related to cognitive frame preference? Because this was an exploratory study, we used correlational analyses to test for association between the variables listed in Tables 1 and 2. Later, we will apply these associative links to relevant implications for training.

Good Stranger Frame

As expected, participants preferring GS frame were more likely to use the tactics and skills related to building trust, instead of security. The Good Stranger frame was associated with increased priority for De-escalation, $r = .25$, $p < .05$ and Building Rapport, $r = .32$, $p = < .01$, and decreased priority for Security, $r = -.38$, $p = < .01$.

Mission Frame

Similar to the GS Frame, participants that prioritized the Mission frame higher demonstrated decreased priority for Security responses, $r = -.28$, $p < .05$. They also showed increased competence for the GS skills and tactics listed in Table 2. $r = .27$, $p < .05$.

Authoritarian Frame

Participants that highly prioritized the Authoritarian frame over-prioritized security responses, rather than using GS tactics and skills. High Authoritarian frame scores were associated with high prioritzation of Security, $r = -.38$, $p < .001$. The Authoritarian frame was significantly correlated with decreased priority for Perspective Taking, $r = -.23$, $p < .05$, Building Rapport, and lower overall Ability Scores, $r = -.35$, $p < .05$.

Rules & Procedures Frame

Interestingly, participants with high Rules and Procedures frame preference reported lower confidence ratings for De-escalation, $r = -.28$, $p < .05$, Voluntary Compliance, $r = -.23$, $p < .05$, and Security, $r = -.27$, $p < .05$. These individuals were not confident in performing any skills and tactics.

DISCUSSION

Theoretical Contributions

The results of this study further confirm the link between the GS frame and certain trust-building tactics, such as building rapport, gaining voluntary compliance and de-escalation. Using short scenario-based assessments, we can identity participants that prefer to use this frame in social encounters. GS frame preference significantly

predicted De-escalation and Building Rapport, and negatively predicted excessive Security. Using the GS Diagnostic Tool, we found that other frame types, like the Authoritarian frame, significantly predict decreased prioritization and understanding of certain trust-building tactics, such as De-escalation and Building Rapport. These relationships are consistent with previous SSIM research, investigating the Good Stranger concept and trust-building tactics (G. Klein et al., 2014a, 2014b).

Training Implications

The Good Stranger Diagnostic Tool can provide a description of the learner's initial cognitive frame, response tendencies, and understanding for certain behavioral tactics. Adaptive learning technologies, such as serious game simulators, can use this information to generate individualized learning conditions in order to augment training effectiveness. More specifically, using the cognitive frame assessment, we believe training systems can modify initial starting conditions and how training content can be presented. This can be accomplished by presenting ability-graded examples and or additional practice as needed. We propose the following training recommendations based on our empirical findings.

While some warfighters can switch frames depending on the situation they encounter, others may be unable to adopt a GS frame. Military personnel that prefer a domineering approach may need explicit behavioral rule-based approaches to reduce provocations when they are in contact with civilians. Participants that preferred the Authoritarian frame were more likely to prioritize security over the social tactics and skills, regardless of the situational demands. Specifically, our results indicate they were less likely to prioritize Perspective Taking and Building Rapport. Both of these dimensions are strongly linked to empathy, the ability to recognize and share other's feelings, which Field Manual 6-22 *Army Leadership* indicates as a critical tool in winning support from populations (U.S. Army, 2006). Those who prefer the Authoritarian frame might best be directed to positions that do not require interactions with civilians. Instead, these warfighters would be better suited in positions involving clearly defined rules such as defense and security.

Participants preferring the Rules and Procedure frame showed lower confidence ratings for social tactics and skills (e.g. De-escalation and Voluntary Compliance) and security-based items. Military personnel that strongly prefer a Rules and Procedure frame may benefit from feedback supporting confidence development when needed. This feedback can provide warfighters with the positive assurance needed when making effective decisions regarding security and social tactics (e.g. building trust).

Those preferring the GS and/or Mission frame demonstrated similar response patterns. Both highly prioritized the GS social tactics and skills, and these participants also showed increased understanding for the GS social skills. Because of this, warfighters preferring these frames would benefit from accelerated training. Importantly, this training would also require trainees to make decisions about appropriate times to initiate GS tactics vs. taking a security oriented approach and vice versa.

Limitations

Further iterations are needed to construct effective frame scenarios and response options. To our surprise, most participants preferred the GS frame when making sense of situations. While this may be reflective of our sample, we are skeptical that this represents the population as a whole. We suspect some participants were able to see patterns in the response options and attempted to respond how they *should* rather than how they actually *would*. These demand characteristics can be avoided by creating credible options that are not as obviously right or wrong.

This sample included non-commissioned officers ranking E6-E7 in the US Army. The outcomes provide a specific frame of reference (e.g. diagnostic) for this group. Commissioned officers would potentially generate different response patterns, frame preferences, priorities, confidence levels and abilities. More testing would be needed to describe potential group differences.

The sample included students enrolled in a senior leadership course. Data collection occurred when all participants had a major test in their senior leadership course scheduled later in the day. Due to scheduling issues, participants had less time than we anticipated to complete the study (1.5 instead of 2 hours).

In order to accurately assess outcomes, we included only participants who had completed every question for each segment. Although over 161 participants attended the study session, only about two-thirds of the sample completed all three sections of the GS Diagnostic Tool. Despite these problems, we identified important training implications.

The GS Diagnostic Tool was also able to diagnose individual frame preferences, response tendencies and levels of confidence and ability for specific tactics and skills. This information can assist computer based instructional systems to deliver effective training, accommodating individual ability strengths and limitations. While additional research is needed, particularly exploring the validity of the measures used, we believe some components of our study can be incorporated into ongoing training efforts to augment effectiveness.

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Good Stranger Diagnostic Tool – Addendum A:

The following training recommendations are based on a sample of 78 non-commissioned officers (E6-7) enrolled in a NCO Henry Cairo Leadership Academy, stationed at Ft. Benning, Georgia. This data is meant to provide military leadership and simulation teams with answers about how this sample responded to the social skills outlined by the SSIM team. We have aggregated group response averages to provide the reader with overarching themes and trends from our data. We caution generalizing these findings to all military personnel, NCOs, or even E6-E7s. To make these assumptions, we would need to develop a more comprehensive diagnostic tool, and construct a more rigorous study design. However, we do believe these findings can provide direction for military leaders and trainers developing customized training programs for warfighters.

Cognitive Frames

The type of cognitive frame a person employs significantly influences how they perceive their environment. A frame will affect the type of cues we spot, what expectancies we generate and which goals we attempt to pursue. We identified four major frames (Good Stranger, Mission-oriented, Rules and Procedures, Authoritarian) that military personnel leverage in various situations. Tasks and objectives call for different frames. In a peacekeeping environment, one would benefit from maintaining a Good Stranger frame to build trust with a community, rather than seeking ways to manipulate and control with an authoritarian frame. Team leaders would benefit from knowing the types of frames their team members are partial towards and which frames they dislike, ignore, or do not possess. Importantly, this information is most valuable to the team leader before they start their mission so they can direct personnel to the most appropriate tasks. For example, if someone utilizes the rules and procedure frame, they may not be best suited for a task that involves creativity and thinking on their feet. Someone apt in social interaction skills may be underutilized working on equipment and not interacting with community members.

What are the dominant and non-dominate frames that this group uses to make sense of situations?

- The most preferred frame is the Good Stranger frame (.73)
- The least preferred frame is the Authoritarian frame (.43)
- Frame preference scores are percentages (total average frame score/total possible frame score). The rankings (1 = least prefer – 4 = most prefer) for each of the ten questions were summed for each frame (GS, M, R&P, A). This raw score was averaged across all participants. The average frame scores were then divided by the maximum frame score (40).

This sample displayed more Good Stranger proclivities than we expected. Many assume the Good Stranger approach is out of sync with the conventional warfighter's psyche. However, this data suggests otherwise. The group, on average, preferred responding with actions in line with a Good Stranger frame. They favored cooperation, voluntary compliance and rapport building strategies to build trust with civilians. Our findings suggest that the Good Stranger training strategies being developed by the SSIM teams may not be as difficult to employ as many expected.

Not surprisingly, this group showed an almost equally strong preference for the Rules and Procedures frame (.71). They highly prioritized actions that insisted on following rules, which is characteristic of hierarchical organizations such as the military. However, complex and turbulent situations require warfighters to think outside of simple rules and procedures that are oftentimes futile in these environments. Because of the group's strong preference for a rule-based frame, they may not manage chaotic situations effectively. Simulation training can provide extensive real-world experience in these complex situations, which can build expertise and prepare warfighters for these situations.

Follow on research should investigate if and how warfighters are able to modify their frame depending on their circumstances. It would be advantageous for training personnel to know if warfighters can switch their frame quickly as situations change over time. Modern warfare requires the military to engage in kinetic and peacekeeping environments. Oftentimes warfighters must simultaneously juggle both types of situations (e.g. counter insurgency missions). More work is needed to investigate the types of situations warfighters encounter and the optimal frames for each situation type.

Social Skills – Preference & Confidence

Among the list of SSIM social interaction skills, we closely examined group preference and confidence for de-escalation, voluntary compliance, rapport building, and perspective taking. Specifically, we examined how warfighters prioritize and perceive their confidence in performing actions that manifest these abilities. In addition to these soft skills, we assessed preference and confidence for Security-oriented actions. Understanding how warfighters balance soft skills with security can have important training implications.

Which skills does the group prefer to use?

- They most prefer using de-escalation tactics (.70), in comparison to the other skills
- They also prefer to use security (.60), but not as much as de-escalation and voluntary compliance (.65).
- They least prefer using rapport building (.54), in comparison to the other skills
- Preference scores are percentages (total average preference score/total possible preference score). The rankings (1 = least prefer – 4 = most prefer) for each of the eleven scenario questions were summed for each learning objective (DE, VC, RB, S). This raw score was averaged across all participants. The average preference scores were then divided by the maximum frame score (44).

Are they confident using these skills?

- They were most confident in providing security measures in all scenarios (.88).
- They were least confident building rapport (.75) with civilians and community leaders
- Confidence levels are percentages (total average confidence rating/total possible confidence ranking). The rankings (1 = Not Confident – 5 = Very Confident) for each of the eleven questions were summed for each frame (DE, VC, RB, S). This raw score was averaged across all participants. The average confidence rankings were then divided by the maximum confidence score (25).

Among the soft skills, this sample preferred response options that characterized de-escalation and voluntary compliance tactics. Interestingly, they showed the least preference and confidence for rapport building, which includes behaviors such as searching for shared goals, showing empathy, and promoting common ground. These actions load onto a trust building (G. Klein, H. Klein, Lande, Borders, Whitacre, 2015), which is necessary to successfully stabilize communities in unconventional warzones. Our data indicates that these warfighters are not confident in their rapport building skills; therefore they may not be adequately trained to effectively perform these efforts. Future training would be best directed to emphasize the importance of rapport building on communities. Although these skills are unconventional, they can be critical for decreasing hostility and maintaining security in an unstable region. Until warfighters are confident in their skills, they will not be likely to adopt such behaviors in the field. Simulation efforts are especially valuable, as they allow trainees build experience and confidence developing these skills in realistic situations.

As expected, this group highly prioritized options that were security-oriented. Further, this group was overwhelmingly confident performing the security options. Security-oriented actions are deeply ingrained in military culture (rules and procedures), which provides reasons for the sample's strong tendencies. The ability to establish and maintain security throughout a mission is critical when evaluating success. However, the means of obtaining security can be achieved in various ways. Sometimes it may be prudent to de-escalate a situation by slightly reducing security measures in order to develop long-term trust within a community. The social skills outlined by the SSIM teams provide indirect and subtle paths to achieve security, and they achieve this without vaunting force and coercion. Training programs should leverage the positive long-term impacts that strategic social interactions (e.g. rapport building, de-escalation) have within communities. Law enforcement agencies provide great examples (e.g. community policing) for the military to learn from (Klein et al., 2015). As warfighters begin trusting the effectiveness of these skills (e.g. seeing results), they will be more confident in adopting and employing them in the field.

Does the type of scenario influence the skills they prefer to use?

- Tense situations (with potential to become kinetic)
    - This group preferred using security above the other skills in some stressful situations (broadsided: security (.70)). However, sometimes the security-oriented approach was too extreme. For example, in the scenario, disaster relief, the participants were opposed to the security approach (.47), to shoot the hostiles, even though they were justified to do so.
- Negotiating situations
    - The group preferred using de-escalation tactics when they had to manage groups of people (Shots Into a Crowd (.80); Weapons Harvest (.76))

The scenarios used in this study required the group to manage a range of experiences, and there were no right or wrong response types. There were developing trends favoring de-escalation options for scenarios that focused on negotiating a conflict. De-escalation includes attempting to reduce intensity of situations, remaining calm and impartial, and thoroughly explaining one's actions in a rational manner. The data suggests that warfighters can effectively modify their response type in fit their circumstances. More work is needed to investigate how skill

preferences and confidence levels change in response to various situation types.

Skill Competency

The last section of Good Stranger Diagnostic Tool examined competency for the learning objectives specified in the previous section. More specifically, we examined how accurately the group could identify behaviors that support soft skills. Adaptive training solutions would greatly benefit from knowing how the trainee understands the target skills. More resources can be directed improving areas of weakness (e.g. clarifying misunderstandings), and less time can be spent in areas with high competency.

Are they competent in using the identified soft skills?

- As a group, they are most competent in gaining voluntary compliance (87%, 10.45 correct/12 possible)
- As a group, they were least competent in taking another's perspective (50%, 6/12).
- The group was fairly competent in rapport building (80%) and de-escalation (81%).

The group showed the least competence for the skills involved in taking another person or group's perspective. Perspective taking is strongly linked to empathy, the ability to recognize and share other's feelings, which is a critical skill for building trust. It is possible that low competency for perspective could be linked to an inability to think hypothetically. Warfighters are unable to visualize themselves in another person's situation; therefore, they don't recognize the importance of this skill. Training program should target perspective taking and empathy skills, so warfighters can become attuned to the needs and goals of others.

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Police and Military as Good Strangers

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The objective of this project was to understand why and how some police officers and military personnel are more effective than others at managing civilian encounters without creating hostility – 'Good Strangers' (GSs). We conducted cognitive task analysis (CTA) interviews with 17 US police officers and 24 US warfighters (Marines and Army soldiers). The interviews yielded a total of 38 incidents (17 police and 21 military), which we used to identify critical skills for functioning as GSs. These skills centred on having a sensemaking frame that established a professional identity as a GS – Someone who seeks opportunities to increase civilian trust in police/military. This frame requires skills in gaining voluntary compliance, building rapport, trading off security and other frames versus trust building, and taking the perspective of civilians.

Practitioner points

- To work effectively with civilians, police and military personnel need to use a Good Stranger frame, which casts each encounter as an opportunity to build trust.
- This GS frame requires skills such as trading off security to be seen as trustworthy, perspective taking, gaining rapport, gaining voluntary compliance rather than coercive compliance, and de-escalating tense situations.
- The GS frame may be surprisingly easy to acquire for some police and military; observation of role models and their effectiveness seems to be a powerful training opportunity. Other training leverage points involve peer pressure, becoming more effective at gaining civilian cooperation, and recognizing the problems created by failing to build trust.

The goal of this project was to understand why and how police officers and military personnel can interact with civilians to gain good will and reduce antagonism. We studied warfighters and police officers because they face many of the same challenges and have learned lessons that might be useful. For police, civilian encounters are a primary aspect of the job, whereas civilian encounters have not been a high priority for the military until recently. Police officers have a variety of responsibilities in maintaining law and order (e.g., arresting criminals and providing security in their jurisdictions). Police are trained to gain coercive compliance including various forms of force and direct threats of firearms or

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tasers. However, some officers are skilled at gaining voluntary compliance, which is less likely to make civilians resentful and antagonistic.

The military faces similar issues. Historically, the US military trained warfighters to engage against traditional national forces. They were prepared in the strategies and tactics of the battlefield that involved well-defined adversaries and clear rules of engagement. Soldiers were to adopt a 'warrior' mindset. However, US troops are increasingly called upon to engage paramilitary forces and nationless adversaries in unconventional actions that are less well defined and predictable. They often are charged with fostering the stabilization of local communities. To succeed in these tasks, they have to cultivate good relations with citizens. Simultaneously managing two roles – fighting adversaries and supporting civilians – presents difficult challenges. Just like police, warfighters are more effective in encounters with civilians if they can reduce coercion and prevent antagonism.

But how can police and military personnel obtain voluntary compliance? We recognize that in this context, compliance is never truly voluntary because it is backed up by the potential to escalate to more coercive forms. However, this type of 'voluntary' compliance – compliance gained without direct threats and overt coercion – is less likely to make civilians resentful and antagonistic than compliance gained through physical force, overt threats, and outright coercion.

In 2011, Defense Advanced Research Programs Agency (DARPA) initiated a programme, 'Strategic Social Interaction Modules' (SSIM), to use experiential simulation and other techniques to teach social skills so that military personnel can consistently gain voluntary compliance and maintain cooperative working arrangements with civilians. The goal of the SSIM programme is to help military personnel develop the social interaction skills and human dynamics proficiencies demonstrated by those who are Good Strangers (GS) – To prepare them to create positive outcomes in social encounters. The nickname for the SSIM programme is the 'Good Strangers' project because the intent is to transform military personnel into agents who elicit trust and cooperation rather than hostility.

There is a large literature on ways for police and military to accomplish their missions without being provocative. We surveyed a range of publications on using 'soft' methods of persuasion and influence (Cialdini, 1993; Glennon, 2010; Thaler & Sunstein, 2008; Thompson & Jenkins, 1993/2004; Wilson, 2011). There is no lack of speculation about the skills needed by GSs, but we did not find any in-depth studies of how these skills were formed and implemented by police officers and warfighters. Therefore, we conducted critical decision method (CDM) interviews (Klein, Calderwood, & MacGregor, 1989), a form of cognitive task analysis, with police and military personnel who were identified as GSs, to try to understand what enabled them to work well with civilians. We reviewed 41 military and police reports and identified 24 different knowledge/skills/abilities mentioned in these documents.

Currently, police academies include some form of preparation for interacting with civilians but have expressed a strong interest in expanding this type of training. The military has sought to provide GS training as a result of the counterinsurgency efforts in Iraq and Afghanistan, but the training is extremely expensive, involving a large number of role players in mock-up villages and city neighbourhoods. With the cessation of US military activities in Iraq and the wind-down in Afghanistan, and the reduced interest in counterinsurgency operations, these training facilities are being shrunk or closed. Nevertheless, military forces will still have to interact with civilians and to act as GSs even when they are not conducting counterinsurgency missions. Therefore, the SSIM GSs programme should continue to be relevant to the military as well as to police departments.

As part of the SSIM programme, we conducted cognitive task analysis interviews with police and military to gain a better understanding of the dynamics of GSs, develop training materials and programmes, and advise other SSIM partners who are developing advanced experiential simulations. This article describes our initial findings about how police officers and military personnel GSs make sense of challenging civilian encounters.

Method

Participants

The participants were 17 experienced police officers from four jurisdictions within the United States and 24 warfighters, including both Marines and Army soldiers. The mean age was 39.7 years. Three of the police participants were female, and all of the military participants were male.

Supervisors from each organization selected the participants. We requested interview time with police and military personnel who were acknowledged by their supervisors to be GS exemplars – Professionals who had demonstrated superior abilities (compared to their peers) in engaging with civilians and in de-escalating rather than escalating situations involving conflict. The objective of the data collection was to identify the skills used by GSs and to understand how GSs make sense of challenging civilian encounters.

Data collection method

Job shadowing

The interviewers conducted four ride-alongs: 8 to 10 hr shifts riding with four police officers as they conducted their patrols. The job shadowing involved one observer and one police officer in a patrol car during a shift.

CDM interviews

We used the CDM as our CTA approach (Crandall, Klein, & Hoffman, 2006; Klein *et al.*, 1989). The CDM is an interview-based knowledge elicitation technique that elicits critical incidents to expose different types of expertise. The rationale is that expertise becomes important in handling tough cases. The CDM is a qualitative method, intended to complement more quantitative data collection efforts used by other research teams within the DARPA SSIM programme. Two interviewers conducted all 41 CDM interviews, usually as a team except for four cases where, for scheduling reasons, they had to conduct solo interviews in parallel. Both interviewers have many decades of experience conducting CDM interviews. The interview data were collected in office spaces at the participants' work settings.

Each CDM interview consisted of four sweeps through every incident: A brief initial description, a timeline for the entire incident, identification of decisions and of changes in situation awareness during the incident, and final probes (e.g., hypothetical variations). We asked about specific incidents that the interviewee found challenging. The interviews with police examined challenging encounters with civilians. The interviews with military personnel examined critical incidents the interviewee had experienced with civilians and with local military personnel during overseas deployments. The interviews lasted 39–123 min. The interviews were voice recorded and yielded more than 1,000 pages of transcripts.

Most interviews explored one or two incidents, but several had as many as three or four incidents. Three participants lacked any incident with sufficient detail to allow scoring. We excluded one story that came prior to a participant's military experience as well as six undeveloped stories.

The 41 interviews yielded 92 incidents (44 police, 48 military). We recorded the specific features of each incident along with the initiating event and the interviewee's early sense of the situation, including goals, threats, and key participants. We also recorded the decision points the interviewee encountered in each incident. We defined decision points as critical moments in the incident requiring the interviewee to make a decision. The police incidents included domestic violence calls, patrolling a gang funeral, and traffic stops. The military incidents involved a variety of missions, such as dispersal of protestors, transporting supplies, providing bank protection during money deliveries, de-escalating community anger at an accidental shooting, and handling check points. The material that follows includes examples from our interviews. The details of the examples have been altered to guard the anonymity of participants while retaining the dynamics of the interaction.

Data coding

Interviewer global Good Stranger ratings

Both interviewers independently reviewed each interview transcript and rated the interviewee on a 7-point scale, where 7 = good stranger and 1 = bad stranger. These ratings were based on a global impression from the interviews and the way the incidents were handled. Intraclass correlations (ICC) were used to evaluate rater consistency (Shrout & Fleiss, 1979). The interviewers showed significant agreement, ICC (3,2) = .944, in their ratings. Subsequent to the ratings, to justify their global impressions, the interviewers tried to identify the criteria they were using. The following characteristics contributed to their GS ratings: Showing genuine concern for the needs of civilians, wanting to make a difference in people's lives, anger at other police officers acting inappropriately (e.g., abusing their authority), refusal to take provocations and insults personally (e.g., perspective taking and emotion regulation), taking pleasure in getting thanked after giving citations, and wanting to stay calm in tense situations.

Incident and decision point coding

To better understand the behavioural and cognitive strategies involved in being a GS, we selected each participant's most reflective incident for more thorough analyses. A participant's most reflective incident had to be a complete incident in which the interviewee was heavily involved in the decision-making and outcome of the situation. If the interviewee provided multiple incidents meeting these criteria, we selected the incident that contained the most decision points.

Two independent raters, not involved in the interview process, independently analysed the selected 38 critical incidents (police: 17 incidents, military: 21 incidents). Three of the 41 interviews did not generate an incident that could be coded. Prior to coding, both raters attained mutual understanding of the working definitions of the GS cognitive and behavioural dimensions described below.

Coding scheme

The interviewers' global impressions and additional research conducted within the DARPA SSIM programme were then used to develop a behavioural and cognitive model of GS sensemaking. To mitigate overlapping features, we identified the core cognitive and behavioural principles involved in comprising the GS mindset (Tables 1 and 2). Due to the nature of our data, we differentiated behaviours from cognitive processes.

Behavioural strategies

These strategies involved six actions: De-escalates tense situations, builds rapport, reads non-verbal cues, takes prudent risks, shows curiosity about the civilian's odd behaviours, and polices his/her own colleagues who may be acting inappropriately. These behaviours could be easily identified within the incidents. Raters coded actions taken by the interviewee. For every decision point within an incident, the six behavioural strategies were coded as −1 = maladaptive, 1 = adaptive, or 0 = not present (some incidents did not contain relevant context to each strategy). Cohen's kappa was used to evaluate rater consistency (Table 1).

Cognitive strategies

We identified five frames that comprise that GS mindset: Building trust in civilians, perspective taking, long horizon for anticipating consequences of actions, voluntary compliance, and self-control. Coders inferred the cognitive strategies from transcript data as holistic beliefs and ideologies. Unlike the GS behavioural coding scheme, where strategies were coded for each decision point within a selected incident, cognitive strategy ratings were based on global impressions from the entire incident. Although frame types (i.e., cognitive strategies) and actions (i.e., behavioural strategies) were aligned, there were multiple incidents in which a participant's actions did not reflect his/her frame type. Each cognitive strategy was scored using a 7-point Likert scale (−3 = strong avoidance to 3 = strong preference) with zero indicating no preference

Table 1. List of SSIM Good Stranger behavioural strategies, descriptions and inter–rater reliability agreement

Strategy	Description	Kappa
De-escalates	Attempts to reduce the intensity of a situation or conflict; remains calm and is able to explain actions rationally	.52**
Building Rapport	Seeks to develop a positive relationship with others using an inviting approach	.67**
Reading Non-verbal	Reads body language and facial cues to help make situational assessments	.85**
Prudent Risk	Understands importance of security but is able to gain cooperation without provoking antagonism (e.g., trading off security for trust)	.51**
Curiosity/Ground Truth	Seeks to understand the heart of the problem; impartial and lets the evidence direct blame	.46**
Policing Own	Able to manage team members, holding everyone accountable. Addresses problems when they arise and admits personal faults	.57**

Note. **Significant at the .001 level.

Table 2. List of SSIM cognitive strategies, descriptions and intraclass correlations (rater agreement)

Strategy	Description	ICC
Building Trust	Promotes positive encounters, uses the situation to gain the faith of civilians. Displays Meyers *et al.* 1995 dimension of trust: Ability, benevolence, and integrity	.74**
Perspective Taking	Understands other's actions through ability to see a situation from another perspective	.85**
Long-Term Mindset	Understands long-term consequences for their actions; considers long-term implications before taking certain actions	.65**
Voluntary Compliance	Shows willingness to employ verbal and non-verbal strategies to gain voluntary rather than coercive compliance	.37**
Self-control	Careful not to project arrogance or dominance in a negative way; does not take provocations personally. Able to control own body language	.75**

Notes. ICC, Intraclass correlation coefficient; **Significant at .001 level.

for the strategy. A 7-point scale was used because the cognitive strategies were more subjective than behavioural strategies. With this scale, we hoped to gauge the extent to which the participant demonstrated each cognitive strategy. We would be unable to do this using the 'yes/no' scale employed for the behavioural strategies. ICC were used to evaluate rater consistency (Table 2).

Results

The interviewers' GS ratings were averaged for each participant, generating individual GS scores. The GS ratings for police ($M = 5.09$, $SD = 1.73$) and military ($M = 5.23$, $SD = 1.42$) participants did not differ, $t(35) = -0.26$, $p > .05$. Despite our request for interviews with professionals who were all GSs, our ratings showed that some stood out from the others.

This was an inductive, exploratory study of the qualities and capabilities of GSs. Therefore, we were not testing a specific model or hypothesis. A correlation matrix was used to investigate individual relationships between behavioural and cognitive GS strategies (Table 3). De-escalation, building rapport, prudent risk, perspective taking, long horizon, voluntary compliance, and self-control were significantly related to participant's GS ratings. Conversely, the participants' ability to read non-verbal behaviours, curiosity, and policing own did not relate to the GS ratings. Most notably, we found that building trust was strongly related to participants' GS ratings, $r(35) = .69$, $p < .001$.

All but three behavioural GS strategies (non-verbal, curiosity, and policing own) were significantly related to building trust. All cognitive GS strategies were significantly related to building trust. Among these four cognitive strategies, perspective taking was the most strongly related, $r(35) = .84$, $p < .00$.

Behavioural Good Stranger strategies model

A multiple regression analysis was used to examine whether the GS behavioural strategies significantly predicted the participants' GS rating (Table 4). This model, containing six

Table 3. Correlations between Good Stranger (GS) ratings and behavioural and cognitive GS strategies

Measure	1	2	3	4	5	6	7	8	9	10	11	12
1. GS Rating	–											
2. De-escalation	.49**	–										
3. Building Rapport	.56**	.59**	–									
4. Non-verbal	.26	.25	.09	–								
5. Prudent Risk	.42**	.24	.41	.10	–							
6. Curiosity	.01	−.22	−.01	−.06	.08	–						
7. Policing Own	.20	.02	.03	−.24	.01	.45**	–					
8. Build Trust	.69**	.66**	.74**	.06	.57**	.09	.09	–				
9. Perspective Taking	.55**	.66**	.62**	.14	.42*	.13	.23	.84**	–			
10. Long Horizon	.49**	.47**	.66**	.17	.36*	.10	.23	.71**	.76**	–		
11. Voluntary Compliance	.42*	.75**	.69**	.22	.41*	−.22	−.08	.71**	.73**	.60**	–	
12. Self-control	.58**	.79**	.73**	.27	.37*	−.06	−.01	.76**	.73**	.62**	.75**	–

Notes. *Correlation is significant at the .05 level (2-tailed); **Correlation is significant at the .01 level (2-tailed).

Table 4. Summary of multiple regression for behavioural predictor variables to Good Stranger rating

Predictor variable	*B*	*SE*	β	*t*	*p*
De-escalation	1.22	0.86	.25	1.43	.16
Building Rapport	1.26	0.67	.33	1.87	.07
Non-verbal	−2.11	1.07	−.28	−1.97	.06
Prudent Risk	1.98	1.14	.25	1.73	.09
Curiosity	−0.24	1.31	−.03	−0.19	.85
Policing Own	0.71	0.88	.13	0.82	.42

Note. *B,* un-standardized beta coefficient; *SE,* standard error; β, standardized beta coefficient; *t, t*-test statistic; *P,* significance value.

Table 5. Summary of multiple regression for cognitive predictor variables to Good Stranger rating

Predictor variable	*B*	*SE*	β	*t*	*p*
Building Trust	0.70	0.25	.71	2.73	.01**
Perspective Taking	−0.01	0.26	−.11	−0.40	.69
Long Horizon	0.05	0.17	.06	0.28	.78
Voluntary Compliance	−0.25	0.21	−.25	−1.17	.25
Self-control	0.24	0.20	.27	1.22	.23

Notes. *B,* un-standardized beta coefficient; *SE,* standard error; β, standardized beta coefficient; *t, t*-test statistic; *P,* significance value; **Significant at the .01 level.

predictors, explained 48% of the variance, $R^2 = .48$, $F(6, 30) = 4.66$, $p < .01$. Interestingly, none of the individual GS behavioural strategies significantly predicted GS rating. Two of the behaviours achieved a marginal level of significance, building rapport, $\beta = .33$, $t(30) = 1.87$, $p = .07$, and prudent risk, $\beta = .25$, $t(30) = 1.73$, $p = .09$.

Cognitive Good Stranger strategies model

A multiple regression analysis was also used to test whether the cognitive GS strategies significantly predicted participants' GS ratings (Table 5). The result of this regression indicated that the five predictors explained 51% of the variance, $R^2 = .51$, $F(5, 31) = 6.39$, $p < .001$. This model revealed that building trust was a highly significant predictor of GS ratings, $\beta = .71$, $t(31) = 2.73$, $p = .01$.

An additional multiple regression model was employed to identify behavioural and/or cognitive GS factors that loaded onto building trust. This model significantly predicted building trust, explaining 86% of the variance, $R^2 = .86$, $F(10, 26) = 15.44$, $p < .001$, matching the finding from the correlational data presented in Table 3. Two behavioural GS strategies, perspective taking and prudent risk, significantly predicted building trust, $\beta = .47$, $t(25) = 2.94$, $p = .01$ and $\beta = .22$, $t(25) = 2.56$, $p = .01$ respectively.

Discussion

The purpose of this project was to better understand what it means to be a 'Good Stranger' in encounters with civilians. Our study suggested multiple factors are significantly related to participant's GS ratings (Table 3). Among all cognitive and behavioural GS strategies,

building trust stood out as the most significant predictor variable of participant's GS ratings. Multiple regression analysis revealed that the ability to take another's perspective and gauge prudent risk significantly predicted building trust. There was a temptation to formulate a GS model around these factors, given that they have some empirical support. However, we chose a different approach. We did not want to compile a laundry list of GS features – A list that could be expanded in the future but lacked coherence.

Instead, we used a sensemaking perspective to understand GSs. We reviewed our interview materials to try to capture how GSs make sense of civilian encounters in ways that the participants with lower GS ratings did not. We used the data/frame model of sensemaking (Klein, Moon, & Hoffman, 2006a,b) to guide our approach. We did not apply all or even most of the aspects of the data/frame model to our findings. We used the aspects that we believed would help us gain a better understanding of GSs. We posited a GS frame based on our CTA interviews. The concept of a GS frame was not hypothesized at the outset of our research. Our interviews suggested a GS frame of seeking to build trust and that this trust-building frame could be considered as a form of sensemaking. Warfighters and police officers with this frame seem to interpret situations differently than those who lack the GS frame and rely on the standard frames of self-protection, mission accomplishment, and compliance with regulations to sort out what is important in a situation.

We then augmented this account by drawing on the recognition-primed decision (RPD) model (Klein, 1998) which postulates that recognizing a situation involves four aspects: Cues to monitor, expectancies, plausible goals, and potential courses of action. We used these four aspects as four slots in a sensemaking frame. In so doing, we believe we have made a theoretical contribution by synthesizing aspects of the RPD model with the data/frame model. Thus, police and military personnel with a GS frame will notice different cues, form different expectancies, generate different goals, and consider different courses of action than those who lack or do not use a GS frame.

Good Stranger frame – Gaining civilian trust

We speculate that the basic GS frame is about trying to gain the trust of civilians. Figure 1 shows trust building as the core GS frame. The slots in this frame identify what a GS would expect in the process of building trust, the cues a GS would be sensitized to, the goals a GS would have relative to building trust, and the kinds of actions a GS would consider in an encounter. The GS frame would involve different expectancies, cues, goals, and actions than alternative frames such as trying to ensure security, accomplishing a mission, following regulations, or establishing dominance over civilians. Figure 1 shows these other frames; the GS frame co-exists with the others. The frames for security, mission accomplishment, and adherence to regulations are essential for police and military personnel; it is the GS frame that is optional. Many police and military personnel do not have or use a frame for building trust in their encounters with civilians.

Trust appears to be critical for establishing and maintaining the good will of civilians and even adversaries. Mayer and his colleagues (Mayer, Davis, & Schoorman, 1995; Schoorman, Mayer, & Davis, 2007), working primarily with Westerners in organizational settings, identified ability, benevolence, and integrity as dimensions critical for establishing trust during encounters. Their research suggests that trust can reduce hostility, increase information flow, and garner co-operation. Trust eases negotiation and increases operational effectiveness during complex and dynamic interactions. Gottman (2011) has investigated the centrality of trust for relationships between couples. The dimensions

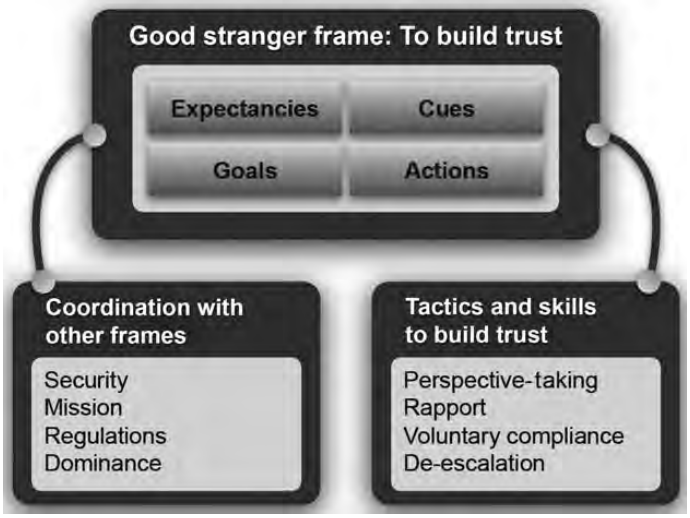

Figure 1. The Good Stranger frame of building trust.

used to assess trustworthiness vary significantly by national group and situation (H.A. Klein *et al.*, 2014). Dimensions beyond Mayer's three include cognition (Markus & Kitayama, 1991), social values, and priorities (Hofstede, 1980) as well as the ones identified by H.A. Klein *et al.* (2014): Affect, non-verbal communication, dialectical reasoning, interdependence, and status. Drawing on a variety of literatures and research, but primarily from the CDM data we collected in this effort, we define GSs as police officers or warfighters who seek to increase trust during encounters with the local populace while carrying out their responsibilities.

The GS frame is about wanting to increase trust from beginning to end of an encounter, and boosting the trust given to the organization (i.e., other police or military), not just the individual. The GS activity seeks to build social capital. In contrast, the interviewees with low GS scores showed little evidence that they viewed encounters with civilians as opportunities to build trust.

One question to consider is whether military personnel are operating under the same constraints as police. Warfighters need to gain immediate compliance and are less concerned with establishing relationships because they rotate fairly often in contrast to police who usually work within the same community. Therefore, police may worry more about trusting relationships than military personnel. However, when we asked our military participants whether it was important to build trusting relationships, they argued that while they themselves might never see a civilian again after an encounter, other warfighters would bear the consequences of their interaction. Thus, GSs in both police and military saw value in short-term and long-term perspectives.

Building trust has a short-term component – Viewing any encounter as a means of gaining more trust for oneself and one's service. From the start to the end of the encounter, a GS is trying to 'move the needle' and be seen as more trustworthy, which will bear dividends in the short term, such as gaining immediate compliance, and the long term, such as increasing cooperation with warfighters who enter into the next encounter.

Building trust also has a long-term component, which is to engage in actions and policies that encourage civilians to take actions that have some risk, such as reporting on improvised explosive devices (IEDs), providing information about insurgents, asking for help, providing help, and so forth. An example of the long-term trust created by GSs is the

incident we heard of the Scorpions in Iraq – The nickname of an Army National Guard unit from Idaho. The Iraqi populace was struck by the benevolence and integrity of the Scorpions, especially in comparison with the unit they replaced. The preceding unit had shown little regard for trust building. Instead, they sought to use intimidation to gain compliance, and the civilians resented this treatment. After the Idaho National Guard unit rotated in, they had more damage to undo. This unit took a different approach. Despite maintaining a firm defensive posture at all times, they strived to be polite and courteous to the community members. They respected the local populace and recognized they were visitors on their land. To work effectively, they explained their actions and demonstrated transparency when possible. This unit worked hard to show the Iraqi civilians that they were trustworthy, and their efforts paid off. When Iraqis saw vehicles with a Scorpion logo, they acted differently and were more cooperative and trusting. Soon the Scorpions were labelling all of their vehicles with a Scorpion sign (sort of like gang graffiti) and, more importantly, were united in their desire not to spoil their 'brand'.

While our sensemaking account of GSs centres on their trust-seeking frame, in other contexts, we might refer to a *mindset* that they have, or a *stance* they take. All of these terms describe what sets them apart – At least in our interpretation of the interview records. We primarily use *frame* in this paper because it fits with our views on sensemaking.

Acquiring the Good Stranger frame

The interviewees showed great variety in how they became GSs. *Early family experience* was important for some people. One military interviewee reported: 'It's probably from my family. At dinner, you could have an argument but you always listened to what the others said. That way everyone come out getting along. Now when I walk into a meeting I'm prepared for arguments but I try to listen to others needs and come up with plans that make my actions more acceptable to people'. Another interviewee said: 'For this mission, I went back to how I was raised: To greet people, to smile at people, to shake hands, because that's what I knew and what I'm comfortable doing'.

Some interviewees adopted a GS frame as a *rejection of negative experiences*. One military NCO (non-commissioned officer) explained that 'when I just started there was a lot of issues with hazing. Things happened that I didn't particularly care for. I decided I was going to do the opposite of what some of the people I encountered did'.

Prior work experience also shaped interaction with citizens. Military interviewees with experience as police, social workers, or missionaries (several of the National Guard participants were Mormons) would mention these past experiences. One officer described a less usual experience: 'One summer, I was a security guard at a shopping mall. People were there to have fun. But people can get angry if somebody pushes them and it's crowded and hot. One of the things I learned was how to defuse the tensions before you have a situation. I used this 'defuse the crowd concept' overseas. I'm good with groups where not everybody gets along as long as they have a common goal'.

Finally, some interviewees were *driven to be more effective*. They adopted the GS frame because it helped them accomplish their missions. One reported: 'To get anywhere with Afghanistan or Iraqi nationals the nicer you are to them, the nicer they are to you'.

Particularly for the police, a GS frame can be an important aspect of professional identity. For example, a number of police officers described how they started out expecting that the job of the police force was about catching and arresting criminals and drawing on their authority to gain compliance. But somewhere along the way, often with

an experienced mentor – for example a field training officer – they observed a different approach. They encountered role models who spoke softly rather than yelling, who treated civilians with genuine respect, and as a result were extremely effective. One officer explained that after working with such a mentor, he cut the number of fights and violent encounters by 90%, using methods he had learned for gaining voluntary compliance.

Our interviews suggest that some professionals may never acquire this GS frame. It is not part of their conceptual repertoire. Others may have acquired the frame but do not activate it very often. These were the participants to whom we gave low GS ratings.

Training police and military to be Good Strangers

We believe that it may be possible in a relatively short period of time to convince military (and police) of the value of having a GS frame and to start them on their journey to acquiring the skills to put this frame into action. It is like making a discovery, although the discovery will have to be followed by practice and refinement so that the GS frame becomes more natural.

The reason we think that the acquisition of a GS frame can happen relatively quickly is that the interviewees, particularly, the police, offered many examples of how they started off without any appreciation of the GS frame and then were struck by seeing it in action, used effectively by others whom they respected. We identified several different pathways contributed to the acquisition of a GS frame:

- Role models,
- Peer pressure,
- Increased effectiveness,
- Norms and performance expectations, and
- Increased security and consequences.

The most dramatic incidents revolved around *role models*. The police in particular described how watching a mentor, perhaps a first field training officer, opened their mind and changed their professional identity. Watching someone speak softly and respectfully and gain compliance illustrated a power they wanted to have. We did not obtain comparable examples of GS role model inspiration in the interviews with military personnel. Even when asked about potential role models, none of the military interviews could think of anyone.

Peer pressure was another motivation. Police officers do not want to ride with bad strangers because they increase risks that simple conflicts will escalate unnecessary. Military personnel seen as creating unnecessary hostility were sometimes sidelined and prevented from engaging with civilians, even though their courage and combat skills were appreciated. The pressure was primarily negative, not to behave stupidly and disrespectfully to civilians, but there was also a positive component: To skilfully elicit voluntary compliance where possible.

Several participants, both military and police, explained that they wanted to learn to be GSs because of *increased effectiveness*. In many situations, GSs can accomplish their mission more quickly and effectively, and with better consequences.

Norms and performance expectations came up in some of the interviews. In some settings, the lesson conveyed was that this is what other military/police are able to do. In these situations, the leaders expected subordinates to act as GSs.

Increased force security was a surprising item, especially in the military. Several participants explained how long-term security is enhanced if the unit is perceived as trustworthy, as in the example of the Scorpions. This factor ties into the finding in the Results section about the importance of *long-term consequences*.

The law enforcement community already has some training programmes for the supporting skills shown in Figure 1, that is building rapport and resolving conflicts. The verbal judo approach to gaining voluntary compliance (Thompson & Jenkins, 1993/2004) is widely used throughout the United States. The military is just starting to stand up training in these GS subskills. As stated earlier, we identified 41 police and military documents addressing different aspects of GS behaviour. However, most of these documents simply acknowledged the importance of the skill, rather than setting forth a training programme. Furthermore, none of the material we reviewed took a sensemaking perspective to GS behaviours or conceptualized a GS frame of seeking to build trust from the beginning to the end of each encounter with civilians.

Skills for supporting the Good Stranger frame

The behaviours we identified in Tables 3–5 informed the GS diagram shown in Figure 1, which shows a set of other frames the GSs may be using in conjunction with the GS frame. Figure 1 also refers to tactics and skills that are needed to augment trust-building efforts; these emerged from our research.

We also heard several examples of deliberate attempts at 'swift trust', a skill at rapidly gaining trust in encounters with strangers (Meyerson, Weick, & Kramer, 1996), particularly in the police interviews.

Coordinating the Good Stranger frame with active sensemaking frames

Police officers and warfighters have several ways for making sense of situations, particularly maintaining control during encounters (Alpert & Dunham, 2004), ensuring security, and accomplishing missions. The concept of a GS frame does not mean police or military can, or should, abandon their other frames. There will be times when police and military need to escalate to the use of force to maintain control of others (Pinizzotto, Davis, & Miller, 2006).

Each frame (e.g., security, mission accomplishment, GS) affects cues, expectancies, goals, and actions. Some police and warfighters also have a frame about how to dominate others. Police refer to such officers as 'badge-heavy'; the military tries to keep them away from civilians. This frame to dominate and intimidate others is inconsistent with the GS frame; we list it in Figure 1 because it is a frame that some police and military have, and a frame that some GSs have had to shed.

We also appreciate that some situations discourage the use of a GS frame. Police and warfighters must put self-protection first. Yet even in these situations, GSs can sometimes find a way to maintain their own security without totally sacrificing trust building. Police officers may have to arrest lawbreakers, but they can make the arrest in ways that are less humiliating.

One of the factors that was significantly related to the GS ratings was awareness of long-term consequences. The long-term perspective acknowledges that security can be increased when one accepts a slightly greater immediate risk to gain trust. Therefore, the issue may not be trading off security versus trust building, but rather considering

long-term consequences as well as immediate motivations. The skill here is to determine how to take prudent risks while using a GS frame.

One of our incidents involved a Marine captain who was assigned the mission of restoring stability in an Iraqi town. He arranged a meeting with the town leaders, which went well, but as the meeting drew to a close, he heard shots. He rushed outside and learned that one of his own Marines had accidentally discharged his weapon into the peaceful crowd gathered outside the meeting hall. Three children were wounded, one seriously. He had his medics treat the wounded. The next day he had another meeting scheduled, and he had to decide how to show up. Should he bring a full contingent of Marines, for protection? Or should he just bring the same size unit that he had the previous day, so as not to be provocative? He chose a third course. He brought only four other Marines, and he walked to the meeting, carrying just a pistol concealed under his protective vest and wearing a cap instead of a helmet. He explained that he deliberately wanted to be vulnerable to reduce tensions. He also explained that his actions in treating the wounded and taking responsibility for the tragic accident helped him to gain trust. The incident actually worked in his favour because of the way he handled it.

Perspective taking

To effectively take on a GS frame, the warfighter will need to be able to take the perspective of others. The skilled GS can grasp what is motivating others and how these others are making sense of a situation. They can also anticipate how the civilians are likely to react. The skill of perspective taking seems essential to taking on the GS frame, and our data showed a significant relationship between them. Perspective taking allows genuine respect rather than contempt because the GS will appreciate that there is a reason for unusual behaviours. It permits genuine empathy because it acknowledges the goals of others. Field Manual 6–22 *Army Leadership* recognizes empathy as a critical attribute to leadership and a useful tool to win support of a population (U.S. Army, 2006).

One police officer that happened to be head of a SWAT unit described an encounter with a man who had stabbed another man and was barricaded inside his house. The officer decided to try to get the man to come out peacefully. The man shouted that he was not coming out – He knew the police were just going to throw him to the ground. The police officer realized he now had an opening. He told the man that they would not throw him to the ground. If he followed directions and came out peacefully, they would handcuff him but would not force him to the ground. Relieved, the man did agree to come out and was arrested quietly and without incident.

The GSs try to get into another person's head, to feel what another might feel and to sense what the person would see as a satisfying resolution. If GSs can imagine how it would feel if people were to push their way into their own homes, they would be more likely to seek a less offensive way to carry out their missions. For example, one soldier explained how he managed interactions respectfully, 'When I worked a check stop, I try to keep in mind how it would feel to have a stranger from a foreign country stopping me and demanding my identification'.

Culture imposes limits on perspective taking. Military interviewees often arrived in a country lacking knowledge of cultural variation. They might understand the universal imperative of demonstrating respect but not the culture-specific ways of doing this. Assuming Western signs of respect to be universal can convey the wrong message. Direct eye contact may indicate respect in one place, while in another, one should divert one's gaze to convey respect. Warfighters cannot readily put themselves in the other person's

shoes (which is a standard technique in perspective taking when dealing with one's own culture). The warfighter has to really stretch to imagine how foreigners are making sense of a situation.

Perspective taking often depends on careful observation to gather information on the other's goals, fears, and values. It depends on understanding how status differences (gender, age, kinship, power status) contribute to the situation. Recently, some research has examined factors supporting multicultural perspective taking (Rentsch, Gunderson, Goodwin, & Abbe, 2007), and ways to increase perspective taking skills (Gehlbach, Young, & Roan, 2012; Roan *et al.*, 2009). There is also some literature on the process of gaining empathy with others to understand what they think and feel (Ickes, 2003), but we did not locate any guidance for police/military personnel. Klein (2004; Klein & Kuperman, 2008) described a cultural training approach, the cultural lens model, which is specifically aimed at helping people gain the perspective of someone from another culture.

In trying to understand why another person has acted in an unexpected way, a GS might consider a few factors: The person may have a different motivation; the person may have a different set of priorities; the person may be operating under a different set of constraints; and there may be a mismatch in knowledge – The person may lack some knowledge or, conversely, the person may have knowledge that the GS lacks.

Gaining rapport

The skill of gaining rapport with others seems very useful for building trust and for voluntary compliance and cooperation. It was significantly correlated with the GS ratings. Rapport covers a variety of subskills. Collaborators on the DARPA SSIM programme identified a set of important rapport-building behaviours (Damari & Logan-Terry, 2015), and these are listed below:

- Acknowledging the goals of the civilians. Where appropriate, helping to pursue these goals,
- Searching for shared goals. Where appropriate, adding those goals to yours,
- Establishing and demonstrating empathy,
- Getting civilians to like you,
- Promoting common ground, and repairing common ground when it has been breaking down,
- Demonstrating respect for civilians, as opposed to contempt for the way they conduct themselves,
- Having a positive attitude and orientation towards civilians,
- Showing appreciation and offering praise,
- Refusing to personalize insults,
- Trying to remain calm,
- Using social gaze – Maintaining eye contact as a sign of connection except in cultures where prolonged eye contact creates discomfort or is seen as rude,
- Being able to listen well,
- Being familiar with rituals such as greetings, farewells, and thank yous, and
- Being ready to engage with strangers.

During this project, we heard about the 'chat-up man' identified in British Army units – The soldier that others turn to for meeting and connecting with unfamiliar civilians. Such soldiers reduce fear and offer reassurance to nervous populations.

Voluntary compliance and cooperation

The skill here is to bend the person to your will without using force or threats. This is the power of influence and persuasion. It goes beyond the simple formulae of verbal judo, as used by police officers (Thompson & Jenkins, 1993/2004). Voluntary compliance taps into the work of Cialdini and colleagues (Cialdini, 1993; Goldstein, Martin, & Cialdini, 2008) on influence and persuasion. It is a key method for implementing the GS frame because military and police have to get people to choose to do what they do not want to.

We identified a range of different approaches to gaining voluntary compliance. These include the work of Cialdini and colleagues on influence (Cialdini, 1993; Goldstein *et al.*, 2008), Amdur (2011), Carnegie (1936), Glennon (2010), Haley (1963), Klein (2009), Thaler and Sunstein (2008), Thompson and Jenkins (1993/2004), and Wilson (2011). One of the striking features of this literature is that with very few exceptions, none of the authors cites any of the others. This is a very fragmented literature, suggesting an opportunity to try to synthesize the different traditions (Klein, 2013) into a general account of voluntary compliance. Weinschenk (2013) has provided a good summary of voluntary compliance methods.

De-escalation

Some of the incidents showed impressive mastery of de-escalation in difficult situations. For example, a military participant described an incident during a tense period, when rumours started that a shrine in a neighbouring district had been desecrated and worshippers mistreated. An angry crowd moved towards the military base. The officer in charge decided to engage the crowd rather than confronting it. He directed his subordinate Marines to stand by while he, his translator, and a senior civilian aid worker made the encounter with the crowd. He was able to separate the leaders of the crowd, whom he knew, and to ask them to sit down and talk. He explained that he did not believe these rumours to be true but that he would have them investigated and report back to them. As their discussions lasted a long time, the crowd dispersed. He quickly followed up by investigating the accusations and confirming their falsehood with photographs. In the following week, he brought the pictures to all of the leaders involved in the initial confrontation and discussion. The interviewee indicated that there had been no further trouble in that region during the remainder of his deployment there.

The GS frame encourages the use of de-escalation tactics to lower emotional affect before tensions arise out of hand. The interviews suggested four strategies for de-escalating conflicts. First, military personnel need to remain cognizant of the trade-off between trust building and prudent risk. Police have learned how dangerous it is when they intervene in domestic violence incidents to try to de-escalate the fight. Second, the earlier a de-escalation effort is initiated, the greater the chance of success. Conflicts may have tipping points, after which de-escalation is more difficult. Third, perspective taking provides tools for attempting to understand the dynamics underlying the escalation. If, for example, the growing anger stems from differences in motivation, it may be possible to reframe the situation to highlight advantages for both sides. It will be important to look for different constraints and/or different knowledge that have created such resulting anger. Finally, rapport-building activities can prevent and break the cycle of hostility. For example, it will be important to remain calm and listen carefully. It will also be important to avoid taking insults personally.

Conclusions

The purpose of our study was to gain a better understanding of what makes police and military who are GSs so effective. We achieved that goal with the concept of a GS frame of seeking to build trust, distinct from alternative frames, using the data/frame model of sensemaking to explain professional identity.

We relied on a cognitive task analysis method, a qualitative approach better suited to generating descriptions and hypotheses than to testing hypotheses and providing quantitative evidence. We believe our findings have potential value for identifying and training GSs.

We formulated a sensemaking account that views GSs as seeking to gain the trust of civilians, as shown in Figure 1. Note that we are not suggesting that GSs increase their trust in civilians – There is no reason to make GSs unnecessarily vulnerable.

We also considered whether any of the other skills we examined might serve as the top frame, but our opinion is that none of the others has the same capacity for organizing and directing behaviour. It is not enough for GSs to be trustworthy. They have to demonstrate their trustworthiness to civilians. They have to perform actions and in other ways convey to civilians that it makes sense to trust these warfighters or police.

Being able to take someone else's perspective is a pre-condition for demonstrating trustworthiness, but it is not directly communicable. That is why *perspective taking* is a supporting skill for gaining trust. If *rapport-building* was the top frame, police and military might ask why – What is the purpose of the rapport? If *voluntary compliance* was the top frame, then it would fail to address situations that do not involve compliance with requests, such as civilians proactively offering information and suggesting cooperation. If *de-escalation* was the top frame, it would fail to address situations that do not involve interpersonal conflicts. Our conclusion was that the frame of seeking to build civilian trust was the most useful for organizing behaviours and guiding the actions of police and military. Certainly, the issue of trust has come up many times before but never, to our knowledge, in the form of a sensemaking frame that is different from other frames (for security, mission accomplishment, compliance with regulations, or exerting dominance over others).

Caveats

In all but one case, we interviewed police and military personnel identified as GSs, so we do not have a basis for speculating about the wider population of police and military other than through the comments of the interviewees about their colleagues and about other units.

Next steps

One follow-on study would be to examine a broader population of military personnel, not hand-picked for having GS qualities. We are currently in the process of conducting that study. To train GSs, it is not enough to determine what skills and frame they need – It is also necessary to see whether those skills are missing in the general training population.

A second follow-on study would attempt to train military personnel to acquire a GS frame or to strengthen such a frame. We are also in the process of conducting that study, using the ShadowBox training method (Klein, Hintze, & Saab, 2013). We are also developing a training module for one of the enabling skills shown in Figure 1, gaining voluntary compliance and cooperation.

A third potential direction for follow-on research would be to explore the notion of sensemaking frames for professional identity in many specialties; areas other than police or military work.

A fourth potential direction is to test some of the cognitive frames listed in Figure 1. If it was possible to independently identify police or military as relying on a GS frame versus one of the other frames (e.g., to dominate others, to maintain safety, to adhere to regulations), then it should be possible to predict their behaviour when shown challenging scenarios. The professional frame they use should predict what cues they notice, what goals they prioritize, what they expect to happen next, and what response options they favour. Just as people use their frames to understand the world, we should be able to use our knowledge of their frames to understand them.

One final contribution of this research, with potential for follow-on work, is the expansion of NDM theory and methodology. Instead of just cataloguing a list of GS skills, we chose to capture a GS sensemaking frame. We also expanded our concept of a sensemaking frame, drawing on the RPD model, to identify four primary slots, expectancies, cues, goals, and actions. For future work, we might use those slots, and the concept of alternative frames, in conducting interviews and gathering data. Our study expanded how we view sensemaking as a framing process and illustrated the potential for viewing a person's professional identity in terms of the way he/she makes sense of situations, in contrast to alternative frames.

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